Was $100 Now $49

On January 1st the Price Will Advance to $57

Easy to Get

If you will merely mail the coupon to us, an Oliver will be shipped immediately to you for FREE TRIAL.

You need not send a cent.

Keep the Oliver for five days. Use it as if it were your own. Note how easy it is to type.

Note that it is a brand new Oliver, never used. It is not second-hand, not rebuilt. It is our latest and best model, the Oliver No. 9. If any typewriter is worth $100, it is this splendid model.

Save $51 Now

And you get it for half the former price. And on easy terms, if you wish.

This is the identical model used by the foremost concerns, such as The U. S. Steel Corporation, The Pennsylvania Railroad, The Diamond Match Company, The National City Bank of New York, Montgomery Ward & Co., Boston Elevated Railways, Columbia Graphophone Company, Hart Schaffner & Marx, and a score of others of equal rank.

We no longer have an expensive sales force traveling all over the country. Think what that saves in these times! You do not pay for high-priced executives, nor salaried salesmen, nor costly branches in many cities.

You now save the $51 it used to cost to sell you an Oliver. $49 is a from-the-factory-to-you price.

The $100 Model

The machine has not been changed in the slightest. You get the exact $100 Oliver for $49 solely because of our new plan of selling direct.

A free trial Oliver does not obligate you to buy. If you do not want to keep it, send it back. We even refund the transportation charges.

At all times during the trial, you are the sole judge. No one need influence you.

Mail the coupon now. It is your great opportunity to own a typewriter.

Remember the saving will not be as great after January 1st.

Easy to Learn

Anyone can learn to operate the Oliver. It is simple. One picks it up easily.

One may learn the "natural" method or the "touch system."

We have published an instruction book for those who wish to learn the touch system, as taught in the better business colleges.

This we furnish free to Oliver buyers who ask for it when ordering.

It is called "The Van Sant System of Touch Typewriting." It is prepared by Prof. A. C. Van Sant, known for years as the father of improved touch typewriting.

Free Instruction

Ordinarily, it would cost you $40 or more, plus the difficulty of attendance, to take this course at a business college.

You can learn it at home through our charts and instructions. By practice you may rival the speediest operators.

So whether you learn by yourself the "natural" way, which is fast enough for the average individual, or the "touch system" which is the fastest of all, be assured that you will find typing easy.

Thousands of people like yourself have learned. Thousands of school children are learning.

The Oliver is particularly easy to operate because of its fundamental excellencies.

Advanced Ideas

The Oliver was first to introduce "visible" writing.

And ever since the Oliver has been a leader in improvements.

The touch is light, the action largely automatic. The workmanship is of the best.

A free-trial Oliver will prove how simple it is to learn. Get it and see. Mail the coupon.

Easy to Own

At $49 everyone can afford an Oliver.

To big concerns using many machines the saving is enormous, and to the individual, the Oliver is the only hundred-dollar typewriter for $49.

Why Pay More?

More cannot buy a finer machine. In addition to the no-money-down, free-trial, half-price advantages, we offer the Oliver at $3 per month.

How extravagant to buy a second-hand, rebuilt typewriter, or even to rent, when you can own a brand new Oliver so easily!

And you can use it while you are paying.

What offer could be more liberal? We feel that we have gone the limit in self-selling.

We hope to continue this offer, for it has brought satisfaction to thousands of purchasers.

Order Early

After January 1st the price of the Oliver Typewriter will be $57. We are compelled to make this advance because of the increased cost of production. Our plan and the Oliver remain the same. To lower the quality was unthinkable. The addition in cost insures its superiority.

The $49 price of the Oliver has been widely advertised. We want to be entirely fair—so we notify you in advance that if you have been planning to buy at this price you may not be disappointed.

Mail the coupon for EITHER the free trial Oliver or further information. If you use many typewriters in your business, mention it in sending the coupon.

Canadian Price, $62.65 until Jan. 1st, 1919

The Oliver Typewriter Co.
1109 Oliver Typewriter Bldg.
Chicago, Ill. (818)

THE OLIVER TYPEWRITER CO.
1109 Oliver Typewriter Bldg., Chicago

☐ Ship me a new Oliver Nine for five days' free inspection. If I keep it, I will pay $49 at the rate of $3 per month. The title to remain in you until fully paid for.

My shipping point is .....

This does not place me under any obligation to buy. If I choose to return the Oliver, I will ship it back at your expense at the end of five days.

☐ Do not send a machine until I order it. Mail me your book—"The High Cost of Typewriters—The Reason and the Remedy"—your deluxe catalog and further information.

Name .....

Street Address .....

City .....

State .....

(818)

Popular Science MONTHLY

DEC. 1918

Volume 93-No. 6

CONTENTS

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225 W. 39 Street
New York City

CONTENTS

CONTENTS—*Continued*

WAR MECHANICS

MISCELLANY

Here is Your Chance to Succeed through ELECTRICITY

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4700 Pictures

$1 A Number A Month

YOU need specialized knowledge today if you are to master electrical forces and command the high salary of an electrical expert. Success in electricity will come through your ability to acquire and use the specialized knowledge of others—knowledge collected and condensed in Hawkins Electrical Guides.

Just think how much these books will help you. In Hawkins Electrical Guides you always have at hand for immediate reference or study, a wonderful work containing 4,700 illustrations and 3,500 pages which cover all the subjects, principles, theories, practices, problems, troubles and ways of doing things electrically. If you are an Engineer, Electrician, Mechanic, Helper or Student, "Hawkins Electrical Guides" are a necessity in your daily work.

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Also a complete 136-page ready reference index of the complete library. This index has been planned to render easily accessible all the vast information contained in the 10 Electrical guides. There are over 15,000 cross references. You find what you want to know instantly.

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The guides are pocket size. You can carry a volume about with you until you have mastered its contents. The subjects are indexed so that you can find your information instantly, arranged in the form of questions you would ask and the answers an expert would give you. It's like having a famous Electrical authority always at your elbow ready to answer any questions you ask.

The Guides are truly beautiful books with flexible covers, gold title and edges and are well printed in large type on high grade paper. They are a pleasure to study and possess.

The Whole Set Shipped To You Free

Send no money. You must see and examine the Guides before you can realize how valuable they are. It will cost you nothing to look them over. Use them in your work—pick up some information that will increase your earning ability. Decide for yourself that they are the most complete and clearly written electrical books ever published. Every book is complete in itself but the entire set is the best bargain. Accept this unusual offer now—mail the coupon today. If you decide to keep the books you can make settlement at only $1 per month, until paid for.

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THEO. AUDEL & CO., 72 Fifth Ave. New York, N.Y.

Please submit me for examination Hawkins Electrical Guides (price $1 each). Ship at once, prepaid, the 10 numbers. If satisfactory I agree to send you $1 within seven days and to further mail you $1 each month until paid.

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Pop. Sc. Dec. '18

TESTIMONIALS

"Hawkins Electrical Guides are priceless to me. They are the most concise treatise on electricity that has come into my reach."
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Carl Fortes, Benicia Arsenal, Benicia, Cal.

"Through the help I have received from my set of Hawkins Electrical Guides I have secured a position which pays me 100% more than I was receiving before I owned the books."—Harlem Day, Centralia, Ill.

"I find the Hawkins Electrical Guides very helpful in my everyday work."
J. W. Suter, West Penn. Traction Co., Pittsburgh, Pa.

$1 A NUMBER A MONTH

FREE EXAMINATION COUPON

The Tragedy of Middle Age

Only eleven men out of 100 who are 25 today will be able to support themselves at 65.

We are average Americans, you and I, and life, with all its obstacles and disappointments is mighty dear to us.

The days pass—the wheel revolves—and soon or late there comes the realization that the years are piling up and that we are close on to middle age.

Then inevitably there comes the thought:—*"What will I be doing at sixty-five?"*

I look around me sometimes and think of the men I knew at twenty-five. How strong and healthy they all were then! How full of promise and great dreams of the future!

Success in large measure has come to some of them, and I am glad. Others have known the tragedy of dreams faded out, and I can read in their eyes that they have given up the struggle and are content to stay where they are—failures at forty.

And always when I analyze the lives of these men I find the answer to their success or failure in one word—*Health.*

Out of every 100 healthy men who are 25 years old today, 36 will be dead at 65—53 will be dependent on relatives or charity for support—only 5 will be well-off—only 6 will be self-supporting.

We are average Americans, you and I, and I want to tell you something of the need and value of periodic health examinations, and what they have done for me.

I want you to forget, if you can, that this is an advertisement and to view it in the same broad, helpful spirit of sincerity with which it is written—to heed it, I might almost hope, as you would heed the advice of the world's foremost physicians. For it is just that.

We all know that disease does not develop over night. Preceding every illness there is a long period of progressive change or breaking down that you are not wholly conscious of at the time, but which gradually reduces your natural powers of resistance.

The problem would be simple if you could instantly recognize the first beginnings of disease. But you cannot. It works insidiously—below the surface. Often special laboratory or diagnostic tests are necessary.

The trouble with most of us is that we don't know any more about our bodies than the average school-boy. Many a man realizes he is not at the top-notch of efficiency, yet is afraid to see his doctor. Almost blindly he gropes his way through life, fearful of disease and suffering, yet taking no step to prevent it.

I have no doubt at all that nine people out of every ten who read this article will admit that they realize the value of periodic physical examinations.

Six or seven will resolve to get such an examination without delay. But procrastination and the pressure of business will dull the edge of resolution for some of them and only four or five will actually get the examination.

I know exactly how it is because just a little over two years ago I was reading a Life Extension Institute advertisement myself.

I saw the logic of its arguments and I decided to do something. But then—

I put the coupon in my pocket and proceeded to forget it for three weeks—forgot it, in fact, until one of my friends was suddenly stricken and I got to wondering if I was as fundamentally well as I thought I was. So I took the Institute's examination.

It was the most thorough thing of its kind I have ever known. They didn't miss a single part of me. They tested my heart and lungs and kidneys—took my blood-pressure—made a microscopic examination of my blood—tested my eyes and ears—examined my teeth—pored over my personal history blank for traces of hereditary disease—told me about the quarterly urinalyses—literally made a spot map of my body and my entire life.

I tell you frankly that that examination has added ten years to my life. You can't imagine what a load it has taken off my mind. I now know exactly where I stand and just what I've got to do if I want to live out my allotted three-score-years-and-ten.

The Life Extension Institute was founded more than four years ago by ex-President Taft, Alexander Graham Bell, Prof. Irving Fisher, of Yale, Robert W. de Forest, Charles H. Sabin and a dozen hundred other eminent authorities in this country and abroad.

The one and only purpose of the Institute is just this—To teach and broadcast the principles of health that every man and woman ought to know to avoid disease and needless suffering, and to provide regular periodic health examinations at a moderate price to people in all walks of life.

The Life Extension Institute is a public-welfare organization on a self-supporting basis. Two-thirds of the profits are set aside in a trust fund for public health work of a national scope.

Nearly 100,000 men and women have been examined by the Institute and have received in addition its guidance and instructions.

It makes no difference where you live. The Institute comes to you wherever you are. It has it's main office in New York, a branch office in Chicago, and a staff of 5,000 physicians in all parts of the United States.

We are average Americans, you and I, and I come to you today to urge you not to put it off. Business is important—pleasure is important—but nothing is more important than health. Without health there can be no success—no sixty-five without dependency.

Don't put it off. Send in the coupon and learn all about the Life Extension Institute and the great work it is doing throughout the country.

SEND IN THIS COUPON FOR FURTHER DETAILS

P. S. M. Dec.

GENTLEMEN: Please send me without obligation on my part, a copy of (1) *"Neglect of the Human Machine,"* (2) *List of two members of the Hygiene Reference Board* (3) *"The Growing Movement to Prolong Human Life"* and other literature descriptive of the services of the Life Extension Institute.

Name.....

Address.....

LIFE EXTENSION INSTITUTE, Inc. (Dept. R). 25 W. 45th St., New York. Chicago Office: 5 N. Wabash Ave.

How I Improved My Memory In One Evening

The Amazing Experience of Victor Jones

"Of *course* I place you! Mr. Addison Sims of Seattle."

"If I remember correctly—and I *do* remember correctly—Mr. Burroughs, the lumberman, introduced me to you at the luncheon of the Seattle Rotary Club three years ago in May. This is a pleasure indeed! I haven't laid eyes on you since that day. How is the grain business? And how did that amalgamation work out?"

The assurance of this speaker—in the crowded corridor of the Hotel McAlpin—compelled me to turn and look at him, though I must say it is not my usual habit to "listen in" even in a hotel lobby.

"He is David M. Roth, the most famous memory expert in the United States," said my friend Kennedy, answering my question before I could get it out. "He will show you a lot more wonderful things than that, before the evening is over."

And he did.

As we went into the banquet room the toastmaster was introducing a long list of the guests to Mr. Roth. I got in line and when it came my turn, Mr. Roth asked, "What are your initials, Mr. Jones, and your business connection and telephone number?" Why he asked this, I learned later, when he picked out from the crowd the 60 men he had met two hours before and called each by name without a mistake. What is more, he named each man's business and telephone number, for good measure.

I won't tell you all the other amazing things this man did except to tell you how he called back, without a minute's hesitation, long lists of numbers, bank clearings, prices, lot numbers, parcel post rates and anything else the guests gave him in rapid order.

When I met Mr. Roth again—which you may be sure I did the first chance I got—he rather bowled me over by saying, in his quiet, modest way:

"There is nothing miraculous about my remembering anything I want to remember. whether it be names, faces, figures, facts or something I have read in a magazine.

"*You can do this just as easily as I do.* Any one with an average mind can learn quickly to do exactly the same things which seem so miraculous when I do them.

"My own memory," continued Mr. Roth, "was originally very faulty. Yes it was—a really *poor* memory. On meeting a man I would lose his name in thirty seconds, while now there are probably 10,000 men and women in the United States, many of whom I have met but once, whose names I can call instantly on meeting them."

"That is all right for you, Mr. Roth," I interrupted, "you have given years to it. But how about me?"

"Mr. Jones," he replied, "I can teach you the secret of a good memory in one evening. This is not a guess, because I have done it with thousands of pupils. In the first of seven simple lessons which I have prepared for home study, I show you the basic principle of my whole system and you will find it—not the hard work as you might fear—but just like playing a fascinating game. I will prove it to you."

He didn't have to prove it. His Course did; I got it the very next day from his publishers, the Independent Corporation.

When I tackled the first lesson, I suppose I was the most surprised man in forty-eight states to find that I had learned in about one hour how to remember a list of one hundred words so that I could call them off forward and back without a single mistake.

That first lesson *stuck*. And so did the other six.

Read this letter from C. Louis Allen, who at 32 years became president of a million dollar corporation, the Pyrene Manufacturing Company of New York, makers of the famous fire extinguisher:

> Now that the Roth Memory Course is finished, I want to tell you how much I have *enjoyed* the study of this most fascinating subject. Usually these courses involve a great deal of drudgery, but this has been nothing but pure *pleasure* all the way through. I have derived much benefit from taking the course of instruction and feel that I shall continue to strengthen my memory. This is the best part of it. I shall be glad of an opportunity to recommend your work to my friends.

Mr. Allen didn't put it a bit too strong. The Roth Course is priceless! I can absolutely *count* on my memory now. I can call the name of most any man I have met before—and I am getting better all the time. I can remember any figure I wish to remember. Telephone numbers come to mind instantly, once I have filed them by Mr. Roth's easy method. Street addresses are just as easy.

The old fear of forgetting (you know what that is) has vanished. I used to be "scared stiff" on my feet—because I wasn't *sure*. I couldn't remember what I wanted to say.

Now I am sure of myself, and confident, and "easy as an old shoe" when I get on my feet at the club, or at a banquet, or in a business meeting, or in any social gathering.

Perhaps the most enjoyable part of it all is that I have become a good conversationalist—and I used to be as silent as a sphinx when I got into a crowd of people who knew things.

Now I can call up like a flash of lightning most any fact I want right at the instant I need it most. I used to think a "hair trigger" memory belonged only to the prodigy and genius. Now I see that every man of us has that kind of a memory if he only knows how to make it work right.

I tell you it is a wonderful thing, after groping around in the dark for so many years, to be able to switch the big searchlight on your mind and *see* instantly everything you want to remember.

This Roth Course will do wonders in your office.

Since we took it up you never hear anyone in *our* office say "I guess" or "I think it was about so much" or "I forget that right now" or "I can't remember" or "I must look up his name." Now they are right there with the answer—like a shot.

Have you ever heard of "Multigraph" Smith? Real name H. Q. Smith, Division Manager of the Multigraph Sales Company, Ltd., in Montreal. Here is just a bit from a letter of his that I saw last week:

> Here is the whole thing in a nutshell: Mr. Roth has a most remarkable Memory Course. It is simple, and easy as falling off a log. Yet with one hour a day of practice, anyone—I don't care who he is—can improve his memory 100% in a week and 1,000% in six months.

My advice to you is don't wait another minute. Send to Independent Corporation for Mr. Roth's amazing course and see what a wonderful memory you have got. Your dividends in *increased power* will be enormous.

VICTOR JONES

While Mr. Jones has chosen the story form for this account of his experience and that of others with the Roth Memory Course, he has used only facts that are known personally to the President of the Independent Corporation who hereby verifies the accuracy of Mr. Jones' story in all its particulars.

Send No Money

So confident is the Independent Corporation, the publishers of the Roth Memory Course, that once you have an opportunity to see in your own home how easy it is to double, yes, triple your memory power in a few short hours, that they are willing to send the course on free examination.

Don't send any money. Merely mail the coupon or write a letter and the complete course will be sent, all charges prepaid, at once. If you are not entirely satisfied send it back any time within five days after you receive it and you will owe nothing.

On the other hand, if you are as pleased as are the thousands of other men and women who have used the course, send only $5 in full payment. You take no risk and you have everything to gain, so mail the coupon now before this remarkable offer is withdrawn.

FREE EXAMINATION COUPON

Independent Corporation

Division of Business Education

Dept. 7712 119 W. 40th St. New York

Publishers of The Independent

"The Most Satisfactory Weekly Journal in America"

Please send me the Roth Memory Course of seven lessons. I will either remail the course to you within five days after its receipt or send you $5.

Name.....

Address.....

.....

.....Pop Sc. 12-18

Learn Shorthand that Quick

No longer is it necessary to spend months of time studying shorthand. You can master all the lessons in K. I. Shorthand at home in five evenings. Don't doubt this positive truth! Send for free lessons—also convincing proof that this is the simplest, most practical, lowest-cost course in stenography by ***personal correspondence instruction.***

K. I. Shorthand

The Universal Speed-Script

Undoubtedly you have heard of this new and revolutionary shorthand system—the simplest and most practical in the world. Used in the Army and Navy and in numerous other governmental places. Used by court officials, by doctors, business-men, teachers, clergymen, lawyers, reporters—and those in hundreds of other occupations.

It is the *universal speed-script—the easy-to-learn, never-forgetable,* lightning writing.

Not only is K. I. Shorthand acquired with wonderful speed and ease—but it is so standardized as to make for *perfe t legibility* and *absolute accuracy.* Notes years old may be read as easily as when fresh.

Thousands of students have learned K. I. Shorthand who never dreamed they could master the old, complicated systems.

For instance!—E. A. Fulton says: "Four months ago I knew absolutely nothing of the first rudiments of shorthand. *To-day I am holding a position as stenographer in the office of Inspector of Buildings,* where the terms apply almost wholly to building construction."

Henry Dranke writes: "*Already* I can write 50 *or more words per minute* and it took only about a quarter hour each day *for ten days.*"

A. Tompkins, journalist, writes: "Your system is excellent, being *simple,* yet *comprehensive.* I find it *fascinating* in my work as a press correspondent.

The above are but a few of legions of testimonials which we are ready to give you with full addresses.

On 30 Days' Approval

Everybody needs K. I. Shorthand—*those in business and the professions* for their personal ready use—as well as by regular stenographers. It is the greatest time-saver compared to the amount of effort and *insignificant cost* necessary to acquire it. It will help you to record precious ideas instantly. It will do your remembering for you. It developes your all-round efficiency tremendously.

If you are going to be a stenographer, learn K. I. Shorthand because it will *fit you for practical work far ahead of the old systems.* Learn it because you will give greater satisfaction to your employer by enabling you to *transcribe all dictation perfectly,* no matter how complex. No guessing necessary.

Do you know anything about shorthand? Well, then you know that what makes old systems hard to learn is the maze of special rules—positions above, below and on the line—light and heavy shadings, etc. They cause mental friction and retard speed; therefore they do not exist in K. I. Shorthand.

You learn in your own home by our mail tuition course. *You will have all the personal help of our instruction staff that you need.* We are not content to let you shift for yourself after you receive the lessons. When your stenographic competency is established, we award you a recognized Certificate of Proficiency.

Send No Money

K. I. Shorthand is offered on the most liberal terms right now. Do not miss this opportunity. Send immediately for the first two lessons free. *You may then continue the entire course on a month's approval.* Do not send money. We give you a positive guarantee that you can learn or no cost to you. King Institute is incorporated in New York State, $100,000 capital.

Cut out and mail the coupon, or write asking for free lessons, complete information and many more wonderful testimonials. Be sure to mention "Popular Science Monthly."

"Talk as fast as you like. I am taking it down in K. I. Shorthand"

USE THIS COUPON FOR FREE LESSON ENROLMENT

KING INSTITUTE, Inc.
154 East 32d Street, New York, N. Y.,

Please send me FREE, the first lessons in K. I. Shorthand, also full information.

Name .....

Address EE-138

KING INSTITUTE, Inc.
154 East 32d Street NEW YORK, N. Y.

The Classified Advertisements on page 94 do not occupy extensive space nor require elaborate illustrations to tell their stories. They are grouped under separate headings which act as magnets to attract your attention to what they have to offer. Often they lead to just the article for which you have been searching.

Men—Come On!

$175 to $250 Per Month to Start

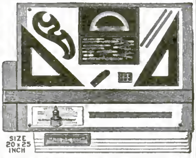
THE big opportunity is here. Come on and fill useful jobs. Be a designer or a draftsman. You men of 16 to 21 and 31 to 60—here is the great chance of a whole life. You are wanted—don't hesitate. Salaries bigger than ever. Positions crying out for men. Help your country and advance yourself. Men eagerly sought for in Ship Building, Munition Plants, War Industries, Railroad Car, Locomotive Building, Special Machinery, Automatic Tool Designing, Modern Manufacture, Labor Saving Appliances and every other line of machinery.

Learn Drafting—Fill Jobs

You who have been waiting to get out of the rut—open the door and come on in. You can have these jobs. You can make this money. I have been training draftsmen for 25 years. I know what they need quick to fill the very jobs open. Mail the coupon below for valuable book explaining how *you* can become a skilled, high priced draftsman in a short time and get the experience required. This book is FREE at present. Send for it TODAY.

Chief Draftsman Will Train You Personally

on practical work. Here is an opportunity for a limited and selected number of ambitious men to receive individual training. As Chief Draftsman ofa large and old established Company I have trained on practical home study work hundreds of men who are now drawing the highest top notch salaries. At present I can accept a faw more to be trained by ma personally **until campetent** and nntil they havs axperience to hold a position as first class draftsman.



Drawing Table Also FREE

In order to train you on regular draftsman's work to get practical working experience, I give you besides all the working tools also FREE a regular adjustable drafting table if I accept you as my student, the same table that I use myself.

This $15 Draftsmans Working Outfit *Free!*

SIZE 20 x 25 INCH

Because of the urgent demand for more and better men in the drafting field I will give absolutely FREE this $15.00 Drafting Outfit to students who enroll right away. I know exactly the quality and kind of practical training and experience necessary to obtain and fill the highest paid positions. This is not a regular correspondece school course.

FREE BOOK OFFER COUPON

Chief Draftsman OOBE
Engineer's Equipment Co.
Div. 1209 Chicago, Ill.

Without any obligation, please mail your book "Successful Draftsmanship" and full particulars of your liberal "Personal Instruction" offer. Also tell me how I can get the training to hold a high salaried position in the department I have checked below.

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Name ....

Address ....

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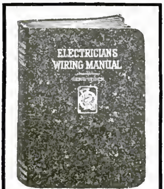

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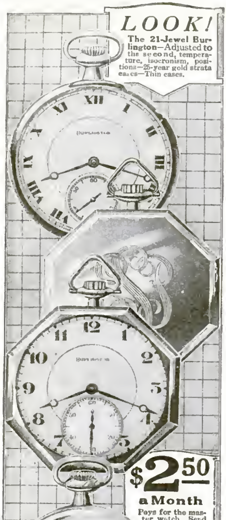

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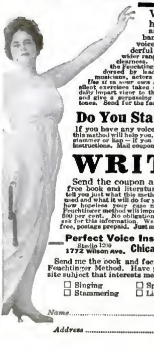

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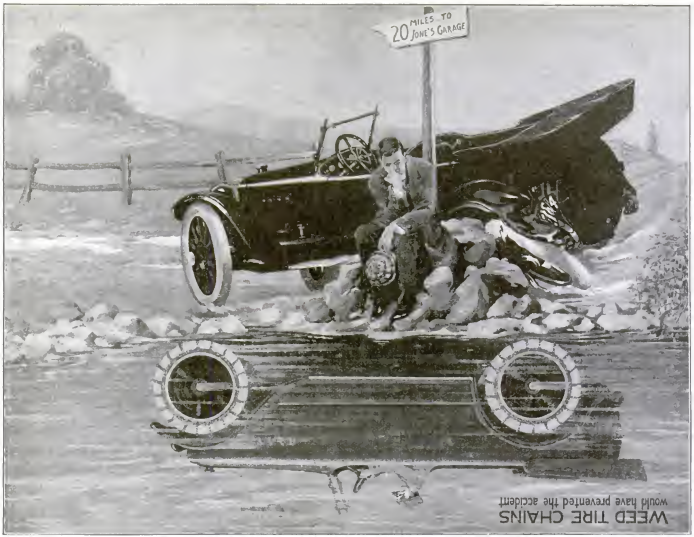

Reflections After the Skidding Accident

Reflections that show Tire Chains as the only real dependable device for the prevention of skidding, do not come to some motorists until their bare rubber tires skid and carry them upon the rocks of disaster. How strange it is that some men are never guided by the experience of others, never take the lesson home to themselves until too late. They read the newspaper accounts of disastrous skidding accidents caused by lack of Tire Chains, but they do not heed the warning. They wait until the skidding of their own bare rubber tires results in death, injury or car-damage before they realize that tires are safe on wet-slippery-skiddy roads *only* when encased in Tire Chains.

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The world's largest automobile insurers, after long and vast experience in handling automobile accident claims, strongly advise the use of Tire Chains on every automobile they insure. The Aetna Life Insurance Company, The Aetna Casualty and Surety Company and The Automobile Insurance Company of Hartford, Conn., now print on their automobile policies the vital information that Tire Chains are the only real dependable device for the prevention of skidding. Could anyone imagine a stronger endorsement?

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Popular Science Monthly

Waldemar Kaempffert, *Editor*

December, 1918; Vol. 93, No. 6
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He Must Face Death Unflinchingly

Why the despatch rider must have one hundred per cent courage

STRAIGHT away for half a mile stretched the road where machine-gun bullets buzzed like bees around a hive, mingling with the whine of the sniper's message, bursts of shrapnel, and an occasional high-explosive shell. Half a mile of rutted and shell-scarred road—a terrible handicap for anything on wheels in peace time, and now an almost certain path to death.

But not one of the six motorcycle despatch riders hesitated. The message must go, and they had volunteered for the job.

"No. 1," called the officer.

No. 1 bent low over his handle-bars and was off. For a furlong he went steadily. Then the watchers saw him crumple up and go into a ditch.

The dust of the shell had not subsided before No. 2 was off. They got him in a scant hundred yards.

Five Riders Go Down

In less time than it takes to tell it, five riders were down. The officer in command of the post raised his hand as though to detain the last man. But, although that rider had seen five men fall, he hesitated no more than had the others. He was off to a racing start before a word could be spoken.

"He's making close to sixty," muttered a mechanic, absorbed in the most thrilling race he would ever see. The watchers saw the rider pass the quarter mark safely; groaned as the machine hit a shell-hole and sailed through the air in a leap it seemed no fabric could survive; cheered frantically as the rider hit the road again safely and sped on; and then drew long, sobbing breaths of relief and reaction as the man disappeared behind the friendly shelter of the wooded hills at the end of the stretch.

What that rider did "Somewhere in France," as told by one who saw it, is what every member of his corps stands ready to do; and with its remembrance tests such as that shown in the photograph below seem easy. The spring-board represents the take-off at the edge of a shell-hole or gully. The machine is tuned to a fifty-mile-an-hour clip, and when it leaves the board it sails rapidly through the air.

© International Film

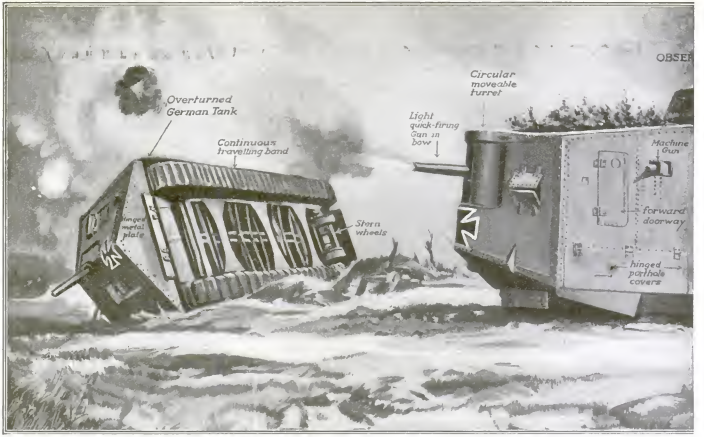
He is taking a leap of thirty-six feet through the air on a motorcycle, as preliminary training for the shell-hole handicap in France

Training for the Motorcycle Corps

This is one of the tests for despatch riders. The camera caught J. W. Terhune, of Hackensack, N. J., in mid-air as he was trying out the spring-board. He made a record jump of thirty-six feet, and came down right side up. If he hadn't, the soft sand at the seashore where the test was made would have treated him more kindly than would the hard packed dirt of a French road.

Recently Terhune's record was broken by Private H. G. Gates, of the United States Army Detachment Training School at Richmond, Va.

Private Gates' jump measured fifty-nine feet three inches.



A German sniper watching in vain for a night prowler

German Monsters—Clumsy

Their thin armor is easily pierced

ALL reports from the front point to the increased efficiency and more general and intelligent employment of tanks. It would certainly appear that the tank has come to stay, and that in future tanks will form an integral part of an army no less than airplanes. The essential utility of the tanks is obviously in attacking and wiping out the machine-gun nests.

The dramatic appearance of British tanks in the battle of the Somme is now a matter of history. It was not until the autumn of 1917 that rumors of German tank construction became prevalent, and apparently no German tank appeared in action until March, 1918. Although in certain respects German tanks have taken the French tanks as their model, their inferiority is obvious and marked. A great increase in weight is caused by extending thin armor

Radium Makes Night-Sniping Possible

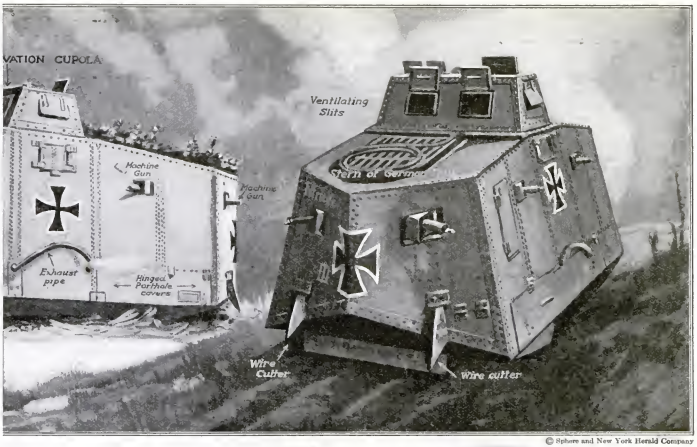
WHEN the Americans first went to France, they took with them not only their equipment and our good will, but also several new and effective inventions for killing bothersome Germans. After the novelty of bombing out the nervous Hun with baseball-bred accuracy had begun to pall, our boys scoured around among their new inventions to find one that would make startled Fritz jump.

They picked out this simple but effective one: slabs of wood coated with radium paint. Then in the dead of night these slabs were stuck in the ground over near the German trenches, the luminous radium surface facing the Allies.

The boys then lay low and waited. Soon a nice fat snooping German silhouetted himself in front of a slab. In less time than it takes to tell, an American sniper had picked him off. True to form, the accompanying Germans turned and ran back to their trenches, thoroughly frightened. How could the Americans snipe in complete darkness?

In the meantime our inventors were busy perfecting this crude weapon. They finally decided to use circular rings of celluloid. These were painted and then hung up on the few trees left in No Man's Land. They proved much more effective than the small slabs.

With calm indifference our boys left the cast-offs standing in the ground. At last Fritz happened on one and carried it back with him. After ponderous consideration as to the function of said article of warfare, one deep thinker figured it out. Fritz triumphantly stuck it up before the American trenches. He is still waiting for an American foolish enough to stand in front of it.



Copies of the French Tanks
and the weight handicaps maneuvers

to protect the caterpillar on which they travel, so that the load carried totals some 45 or 50 tons. All armor surfaces are flat, so that an armor-piercing bullet can obtain full effect by direct impact, and in practice will perforate the thin plating almost anywhere. Only in front is the armor more than an inch thick; elsewhere it varies from two thirds to three quarters of an inch.

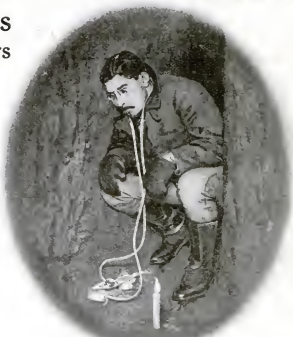
The speed on a level is ten miles an hour; but, owing to the defective motors, which heat very rapidly, this rate can be maintained only for short spurts. The cut-away in front is very shallow, so that the climbing capacity of the *Sturmwagen* cannot be great, and its heavy weight renders maneuvering difficult, if not impossible, on bad ground.

The crew consists of one officer and eighteen men—all this in addition to motors, armament, and ammunition.

Listening to Enemy Sappers

A TENSE moment in the life of an officer of the French Engineers Corps! For hours he has been at his post in the listening gallery, which extends from the first line of trenches in the direction toward the enemy's line. It is pitch-dark in the tunnel, except for the flickering light of the solitary candle. With the ear-pieces of the microphone in his ears, the officer has been listening intently for a long time. The delicate instrument, which communicates even the faintest sound and indicates the direction whence it comes, remains inactive.

Suddenly the features of the officer assume an expression of tense alertness. He has heard a faint vibration of the diaphragm, and his experienced ear tells him the sound comes from the left, and from a level lower than that of the gallery. At first the sound is faint and indistinct, but soon it grows in intensity. It is clearly the noise of pick and shovel, for the scraping and digging can be distinguished. There is no doubt that the enemy is digging a tunnel, the intention being to plant a mine under the French trenches.



This French engineer has been listening for hours, to the digging and tapping of the enemy sappers

What will the officer do? He will report to the commanding officer, and circumstances will dictate the steps to be taken. It may be that an effort will be made to tap the tunnel of the enemy; or, if there is time enough, a countermine will be placed, to be exploded at an opportune moment.

Under average conditions, these microphones can detect sounds within a radius of 200 feet.

© Underwood and Underwood

The Modern Church of St. Emptibox

AMMUNITION had destroyed the village church, and the devout Serbian soldiers stationed near decided that ammunition's next-of-kin should be forced to rebuild it.

So, the rafters of shell-torn buildings served anew, cheek by jowl with poles from the forest; and around this frame were erected walls—solid, weather-proof, passably bullet-proof; built of nothing but old cartridge-boxes filled with earth.

Shells to the Right of Them, Shells to the Left of Them

A POSSIBLE title for this photograph is "The Artilleryman's Paradise."

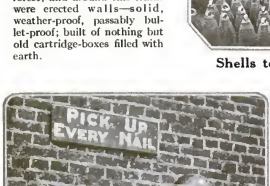
Four women are in sight—not overworked, apparently, by their task of arranging hundreds of tons of metal in a day. The real working force stays modestly in the upper air. It consists, in fact, of a number of traveling cranes, electrically operated.

Her Muffled Mooing Was Futile

THE following sad, unvarnished tale of a cow was enacted one night on a farm in Indiana.

All of a sudden, about midnight, the most awful sounds began to come from the vicinity of the apple orchard. Presently these sounds died away.

Morning and the farmer found a cow with a barrel on its head. In her efforts to get her head out of a barrel of apples, the cow's horns had gone through the sides.

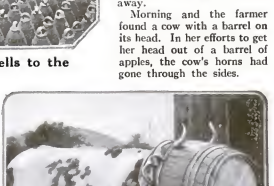


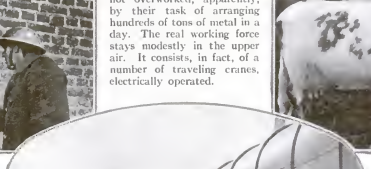
© British official photograph

Nailing the Kaiser

ANY motorist will tell you what a world of harm is hidden in one small nail. In this war one nail can disrupt an entire army; for, in sending troops and supplies to the front, the slightest hitch, such as a tire with a nail through it, will cause delay.

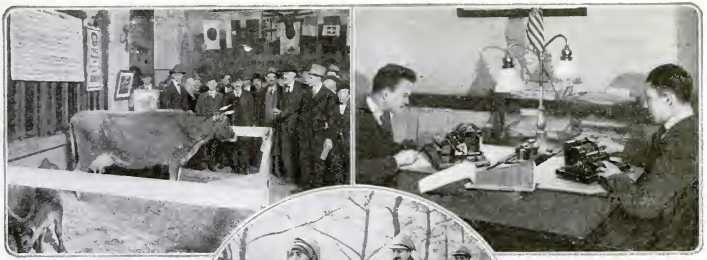
Allied commanders have had boxes like the one above rigged up every half mile or so on the roads leading to the front. Since the sign is written in English, we assume that it is because of the predominence of English-speaking soldiers over there. We wish the Kaiser could see it.





The Queerest Flue

ONE of the queerest, not to say largest, flues in the world is installed in the plant of the St. Joseph Lead Company at Herculaneum, Mo. It is eight feet in diameter and more than a quarter of a mile long; instead of running vertically into the air, however, it runs parallel to the surface of the ground, and serves to carry the gases from the blast-furnaces where the lead is refined to the bag-house, and thence to the brick stack. The flue is made of 3-16-inch iron plates.



A Good Family Cow—in a Bank

ORDINARILY Bossy finds the barn-yard or dairy barn the proper place to function, but not so the milk-producer shown in the photograph.

In an attempt to impress upon his fellow townsmen and the farmers of the adjacent region that a good cow is a profitable investment for both the owner and the bank, Cashier Ed Crow, of the Commercial National Bank in Raleigh, N. C., actually installed a mother cow and her calf in a small pen near the cashier's cage. The walls were lined with data as to the profits in keeping milk cows of good quality, the affair was advertised, and some thirty-five hundred people attended Baby Bossy's coming-out party.

The net result was the purchase immediately of some forty family milk cows, Cashier Crow making good the bank's offer to advance three fourths of the purchase price to any man, woman, or child wanting to invest in a cow.

Wine-Casks Highly Valued in the French Army

"SOLDIERS! Attention! If you want wine, take care of the casks!"

This is the sign that is painted on thousands of casks containing wine for French soldiers at the front. The precaution is necessary because of the large quantities of wine which France sends to her soldiers. At one time it was estimated that a million and a half liters (and a liter is a pint and three quarters) were transported daily in casks to Frenchmen on the battlefields.

One reason for the admonition lies in the fact that the French do not favor the use of new wood for these containers.

A Calculating-Machine for Converting Money

EFFECTIVE team-work with two calculating-machines is shown in the photograph shown above.

In large banking institutions the war has brought about a great amount of business in converting American money into the equivalents of various foreign systems, principally French and English.

By using two machines, as shown, this conversion can be done with great rapidity. One of the machines is used to make the calculations in the usual manner; the other makes only the conversions. As the second machine is specially adapted to this work, a high degree of speed is possible.

These machines are also made in the "midget" form, a field that was formerly controlled almost entirely by the Germans.

The fact that the company that makes the machine is building these "midget" forms is interesting as another indication of our growing independence in all lines of manufacture.

Are the Germans Reforming?

THESE are not our stern pilgrim ancestors "stocking up" a miscreant—they are English soldiers trying out a pillory which they found in a town that the Germans had just evacuated.

It seems surprising that the Germans should resort to this old-fashioned mild form of punishment, and surely it is not due to any reformation on their part. Perhaps, in their greed for a large variety of punishments, they will try almost anything.

At any rate, after these Englishmen had tried it once, they all agreed that they were mighty glad they happened to be born in England instead of in "Deutschland."

But they all agreed that the contrivance had great possibilities as a new style in collars for the Kaiser's personal use.

Making the Traffic Policeman Comfortable

THE efficiency of the traffic "cop," which is of great interest to motorists, is bound to be affected if he is not protected from sun and rain. With this in view, the Columbus Automobile Club of Columbus, purchased "Go — Stop" traffic umbrellas like the one here pictured, for the police of their city.

The familiar metal arms are supplanted by an umbrella of generous dimensions. The panels of the umbrella are alternately colored red and white. On the two red octants appears "Stop" in large white letters; on the white octants at right-angles, "Go" is blazoned in red.

The policeman revolves the umbrella by means of a small handle, as in the ordinary semaphore.

We wonder when he gets time to sit down?

Is Your Child Left-Handed?

Why, according to psychological tests, left-handed people ought to remain so

PARENTS, teachers, and educators have long been puzzled by the left-handed child. Some have argued that the "left-hander" should be taught the use of the right arm; others believe in the saying, "Let well enough alone." Recently a group of psychologists, headed by Dr. W. Franklin Jones of the University of South Dakota, have got on the trail of the left-handed.

Their first move was to study arms in general. They measured the wrists, muscles, palms, bones, etc., of about 20,000 left- and right-handed men, women, and children. They tabulated the results, noting any accidents that had happened to the arms, as well as other useful data.

Which Arm Is Your Larger One?

These investigators found that in every person one arm was larger than the other. Most of those whose right arms were larger were right-handed, and those whose left arms were larger left-handed, which seemed to indicate that we are all born "handed."

But several exceptions to the rule had to be accounted for—persons with longer left arms who were right-handed, and vice versa. It was found that the "handedness" of these persons had been acquired. They had been forced to use the wrong arm, either through some accident or through misguided efforts of their parents.

Now that our "handedness" had been established, the next step was to discover whether harm was apt to result from these "transfers."

On questioning the "transfers," the investigators found that more than half of them had stammered or stuttered at some time in their lives. Was this merely coincidence, or was there some real reason for it?

Brain psychologists advanced the following theory: The brain centers involved in speech are located in one hemisphere of the brain—in the left hemisphere for the right-handed, and in the right hemisphere for the left-handed. If a left-handed child is forced to write with his right hand, his writing center will be developed in the wrong hemisphere. This may result in speech-hesitation.

Measuring the child's arm to discover whether he was born right- or left-handed

Testing the skill of both hands by determining how long it takes to drop steel balls into a tube

Why Some People Stammer

To establish more definitely the proof of this, a stammerer was experimented on. The victim was an eight-year-old boy, a left-to-right "transfer," who had just begun to stammer. The boy was set to writing with his left (major) arm, and in a short time the stammer disappeared. Other similar experiments had the same results.

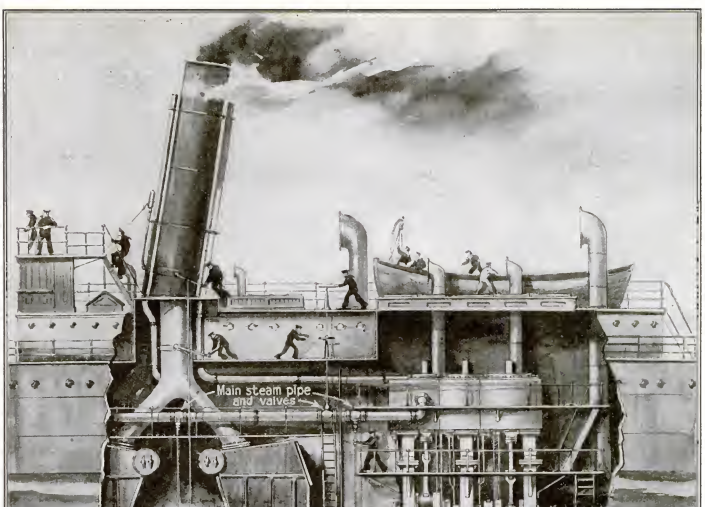
Taking it all in all, this investigation seems proof conclusive that left-handed children should not be forced to use the right hand.

The arm muscles should be relaxed and the fingers spread in measuring the circumference of the wrist

Before the muscle swell of the arm is measured, the subject clenches his fist and shakes it vigorously

The muscle swell of the forearm also helps to determine whether one was born right- or left-handed

After flattening out the palm of the hand, with the fingers touching, a tape-measure is drawn round it



The engine-room force may have been killed or disabled by the explosion of the torpedo, but when the clanging gongs and orders from the bridge have said, "Stop her!" the distribution of the multiple valve-closing hand wheels and levers on the various decks enable the crew to shut the valves in the main steam lines that lead to the engines

The Problem of Stopping a Torpedoed Ship

THE captain leaned far over the end of the bridge on his ship. Frantically he jerked the handle of the cable leading to the engine-room. "Stop the ship! Half-speed astern!"

Two thousand yards off rose the conning-tower of the giant German U-boat which only a few minutes before had sent its missile of destruction into his ship.

Again the captain rang, "Half-speed astern!"

Just then the first of the life-boats struck the water with a great splash, capsized, and threw its cargo of thirty women and children into the sea.

Still the captain rang, "Half-speed astern!" to his engineer.

But it was of no avail. He had no engineer. The engineer and all his men were gone — dead with the first explosion.

This is what happened to the *Lusitania*, and to many other ships that have met her fate. It has happened so many times, in fact, that the marine department of the British Board of Trade has suggested that every passenger-carrying ship be provided with some means of stopping the engines from the deck or skylight hatchway.

Three alternate methods of accomplishing this end are shown in the cross-sectional view of a ship's engine-room shown above.

The first and perhaps simplest method is to insert another valve in the main steam line between the boilers and the engine, and to extend the stem of this valve upward to the engine-room grating on the upper or lower deck level, or clear to the boat-deck through the engine-room hatchway. By attaching wheels to the valve stem shaft, it is possible to close the steam supply to the engines at any one of the desired levels.

A second method is to connect a wire rope to the throttle valve lever and lead it to a point in or near the engine-room skylight hatchway and attach it to a second lever, so that the motion of the latter about its pivot will shut the valve just the same as if the engineer did it while standing level with the base of the engine. The wire rope must be hung with sufficient slack to enable the engineer to operate the valve for maneuvering purposes.

Still a third method consists of fitting an extra stop valve at the junction of the main steam-pipes when a small number of boilers are fitted, and of running the stem of the new valve to the upper deck grating.

When a soldier has music in his soul, it is pretty certain to get out through a banjo. But it took real genius for one of this cheerful pair to build an instrument out of an old canteen picked up in the trenches

Perhaps a bagpipe sounds to you like a pig under a gate, but to Highland ears it is the only music. The same pipes that play the Kilties over the top can set feet dancing. These Scots, enjoying a rest period in a ruined village just behind the lines, are entertaining their battalion with a sword dance

Trying it on the dog, who seems to like it. They are getting a lot of pleasure out of a piano salvaged from a ruined house. Maybe it's American "rag" they're playing — the craze hit Tommy hard

War Is Not

Even the horrors that can't keep the spirits

We hate to tell you, but Juliet is a camouflaged Tommy who made the hit of the trench season in that battle-scarred musical comedy, "Turnip Tops." Thanks to organizations like the Y.M.C.A., it's always possible to stage a show behind the lines

Half a piano is better than none, and the South Africans above found the business part uninjured by the shell that smashed the case

According to the Doughboy song, the cavalry couldn't "lick the infantry in a hundred thousand years"; but it pulls off mighty entertaining horse shows at the rest camps

Happy? You're right. It's his birthday, and the home folks guessed right on how long it would take the packages to get over the water and up to the front. He'll be the most popular man in his company as soon as the news gets around

Not getting enough fighting from Fritz, the irrepressible Scot starts boxing bouts as soon as he gets out of the firing line. It's good fun, and, what's more, it is excellent practice for bayonet fighting, since the principles of attack and defense are very much the same in the manly art and that of the cold steel

This is the trench version of "sitting up with a sick friend"

Always Hell

the Hun has made of brave men down

"Fishie, fishie, come bite my hook—you be captain, I'll be cook." Hardly a war song, but the spectators as well as the judges at this fishing contest between Red Cross nurses on a French hospital barge owe their good fortune to an enemy's bullet

Meet Private Mike Murphy, undisputed champion fish-catcher of the National Army in France. It's a hand-to-fin contest when Mike goes after the fish. His plan is simple: just dive in and pick 'em out. Easy, isn't it? Mike is reported to be particularly deadly when he's after German carp

The Flying "Circus" and How It Fights

The lesson that the wild geese taught us and how it is applied

By Carlyle F. Straub, Aviator Pilot, *Late of the British Air Force*

IN the early days of the war a combat in the air was much like the jousting of medieval knights—a struggle between two champions. In a sense, the General Staff placed its entire reliance on a few extraordinary flyers. This kind of fighting was peculiarly suited to the British temperament. It brought out the very qualities that have made Englishmen great sportsmen.

While the German airmen cannot be accused of being cowards, they are rarely as good fighting flyers as Englishmen, simply because they have not cultivated sports in the British way. Hence we find that the Germans did more, at least in the early days of the war, to improve the fighting machine than the fighting man. When the German Fokker appeared, it seemed for a time as if the machine were more important than the man; but when the Fokker was outclassed by faster machines developed by the Allies, the individual superiority of the sporting British flyer once more became apparent.

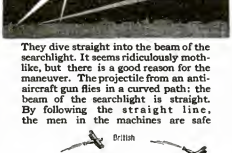
How the Flying Circus Originated

When it became evident that the Allies could build machines in larger quantities than the Germans and that their flyers were individually the more adroit and daring, a new tactical policy had to be discovered. That policy was eventually the adoption of formation flying by the Germans. It proved so brilliantly successful in enabling flight commanders to make the most of a limited number of airplanes, that it has been adopted by all the armies in the field.

It was Bölcke, one of the best flyers that Germany ever had, who seems to have organized the first fighting squadron to offset the individually stronger English fighters. Formation flying was a brilliant success. What were the chances of one or two Englishmen, however brave and skilful, against a whole squadron? For a few weeks Bölcke swept everything before him. Then the Allies adopted formation flying. And the old days when a single man, possibly two men, soared up looking for a German to fight, were over.

The author of this article is a young American who went to Canada before the United States entered the war, in order to join the Royal Flying Corps. During his course of training he received a good deal of practice in bombing squadrons. Since bombing machines usually fly in formation, he writes on his subject from first-hand knowledge.—The Editor.

They dive straight into the beam of the searchlight. It seems ridiculously moth-like, but there is a good reason for the maneuver. The projectile from an anti-aircraft gun flies in a curved path: the beam of the searchlight is straight. By following the straight line, the men in the machines are safe



Surrounded! A hail of lead pours in on the Germans. The only possible escape for them is to dive and throw their machines into a spin

Ten thousand feet in the air, above a concealing cloud, flies the British circus, as shown at the left. Beneath the cloud a solitary Englishman soars. He is so much bait. He looks temptingly alone. Two Germans, regarding him as good prey, begin to nibble, as we show at the right. If the bait can take care of himself the circus above the cloud keeps serenely on its course. But if more Germans should appear, down it plunges, and at once there is a "dog fight"—an indiscriminate combat in which all appearance of formation is lost, and in which each flyer takes care of himself

Reason for the V Formation

One of Bölcke's best men was Baron von Richthofen, a former cavalry officer. After Bölcke was killed in a collision with one of his own men, von Richthofen stepped into the limelight. He organized a squadron of his own. It must have been allowed extraordinary privileges. Von Richthofen himself, for example, always flew in a machine painted a vivid red. The other machines of his squadron were painted in riotous colors. It was this fancy-dress aspect of the machines, coupled with the fact that they were ordered from one sector of the German front to another as they were needed, that led some imaginative Englishman to call the squadron "von Richthofen's traveling tango circus." Now "circus" is the accepted term for such an organization.

I do not know by what method air commanders arrived at the conclusion that it was best to fly in approximately "V" formation. At all events, the distinguished English aeronautic critic, F. W. Lanchester, pointed out some years ago that fast migrating geese and ducks adopt the V. As Lanchester puts it, "the air immediately in

The devil captures the hindmost in the air as well as elsewhere. Two British devils detach themselves from the squadron. Then woe to the straggler!

the wake of a bird in flight has residuary downward motion, and so is *bad* air, from the point of view of the bird following. On the other hand, the air to the right and left of the leader has residuary upward motion, . . . and so is *good* air; consequently the V formation arises from each bird seeking the air which gives the best support."

Formation flying requires the closest team-work. It is not so easy as it looks to keep your station in a flying squadron: it requires constant practice. But, when it is once learned, the pilot has a better chance of escaping death than if he went up alone.

A "Dog Fight" in the Air

It must not be supposed that formation flying begins and ends with keeping station to form a V. The enemy must be outwitted. Three machines climb to a height of 12,000 or 15,000 feet in V formation. Four or five others follow and maintain an altitude of 8,000 or 10,000 feet. At 6,000 feet a single machine—a Nieuport—flies deceptively alone. That lone machine serves the same purpose as the worm on the end of a fishing-line: it is so much bait. Its pilot is a cool, daring, experienced fighter. Suppose that a single German machine swoops

One of the squadron dives down to a height of four thousand feet in order to tempt a German "circus" into action because of his loneliness and apparent harmlessness

down on him. The rest of his squadron, probably concealed for the most part behind a cloud, leaves him to his own devices for a time, confident that he will beat his assailant. But suppose that he manifestly is outmaneuvered? A machine from the squadron detaches itself, plunges down, straightens out, and sideslips into such a position that the enemy machine is caught between two fires.

The enemy seeks refuge in a nose spin, which makes it almost impossible to hit him. His companions see his predicament, and rush to his assistance—exactly what the Allied squadron far up in the air desires most. The leader of the Allies dives first, followed by his right and left guard. Three machines are left above to watch for more enemy machines. Now a general combat ensues, in which each man must fight independently. All semblance of formation is lost; the mêlée is called a "dog fight."

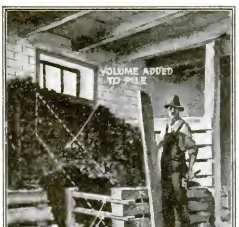
How the Bombers Fly

On bombing raids, which on the English side are usually undertaken at night by giant Handley-Page machines, formation flying is all-important. The individual pilots must cooperate if the raid is to be successful, which means that they must follow the leading machine captained by the commander of the squadron.

But it must not be supposed that the commander hugs secret plans to his bosom. Every detail of the raid is discussed thoroughly with the navigators of the squadron. Maps of the territory to be traversed and attacked are minutely studied. With the assistance of his subordinates, the commander formulates a plan of action. With the aid of red and green wing lights, the machines keep their station in the V formation. If a stabbing enemy searchlight ferrets out the expedition, the leader plunges straight into the beam, followed by the other machines.

When the squadron is a few miles from its goal the commander gives a signal, and the V formation gives place to a single file, so that each machine may follow the leader over the target.

When the Germans have been lured into the trap so cunningly prepared for them by the British, there is a kind of Kilkenny riot which, in the airman's vernacular, is called a "dog fight"—every man for himself



Here's a way to store more coal in the cellar without enlarging the bin

How to Build Up the Coal-Bin

PEOPLE who are trying to store the winter's supply of coal in apartment-house cellars will be interested in the plan hit upon by a certain manufacturing company. By timbering the base of the coal-pile, it is possible not only to store more than double the quantity of coal on the same ground-space, but to prevent waste.

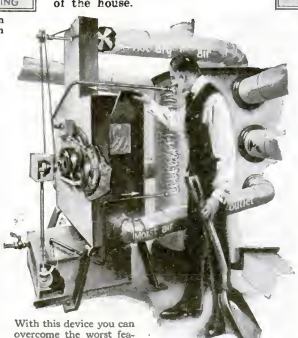
The retaining wall is held in place by horizontal joists placed between the timbers at right angles to them, and these joists are held in position at the other end by spacers. After the coal has been piled up, these act as anchors against the pressure of the coal.

To Moisten the Air from a Hot-Air Furnace

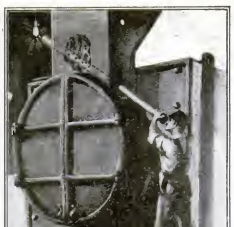
AN invention for moistening the air from hot-air furnaces has recently been patented by Frederic F. Bahnson, of North Carolina.

The hot air is drawn from the top of the furnace by means of a small fan driven by an electric motor.

The hot air passes through a chimney shaft to the moistening chamber. Water is pumped against the blades of a rapidly revolving disk, which atomizes the water into a fine spray, so that it can mix with the hot air. The air is forced back into the air-chamber of the furnace and thence to the rooms of the house.



With this device you can overcome the worst feature of the hot-air furnace



If the light burns dimly there must be too much smoke in the chimney

The Chimney Smokes? Look in the Pipe

TO avoid the wasteful emission of smoke from the chimney by regulating the drafts, D. R. Hibbs, of New York, suggests a simple remedy suitable for manufacturing plants in which the chimney rests on top of the boiler. He recommends running a two-inch pipe through the smokestack at such an angle that the fireman can conveniently look through the pipe when he is standing by the side of his boiler. Several large holes are drilled through the pipe so as to admit any smoke that may be present, but not large enough to affect the draft. At the upper end of the pipe, an electric lamp indicates the amount of smoke in the chimney.

Fill Your Shoes with Hot Air

IF you keep your shoes filled with hot air, your feet can not be cold. But whence comes the hot air? And how is it fed to the shoes? Halls P. Etheridge, of Gilmerton, Va., answers the questions by patenting a small two-cylinder air pump which is placed in the heel of each shoe.

An air pump in your heel operates at each step and pumps hot air to warm your feet

The pistons are operated by the up-and-down movement of the foot, which movement is transmitted to the piston rods by a hinged plate pressed down at each step by the heel of the foot. As it is compressed the air is warmed. Thus warmed it is allowed to escape into the hollow insole of copper which extends forward to the ball of the foot, and thence into the interior of the shoe.

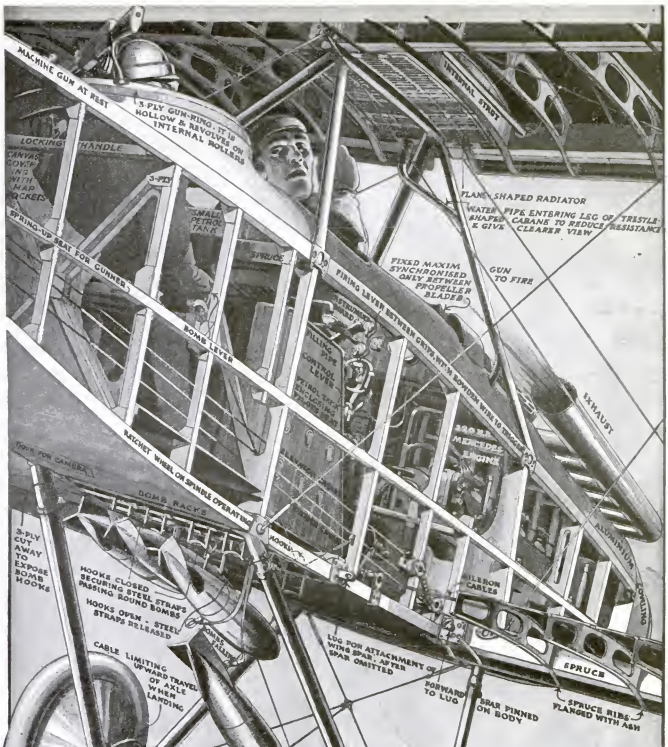
To keep the metal from touching the foot, the copper insole is covered with felt.

This Heater Looks Like a Ruler

THE latest development in electric heaters is one that provides for building it like a flat ruler. The heater was designed primarily for use in outdoor constructional work. The cabs of digging cranes, for instance, often become so cold that the men cannot work. Flat resistances of large capacity have been devised, which are only two feet long and three sixteenths of an inch thick. These can be placed in almost any nook or corner. They can also be used for warming the feet. For this purpose a perforated plate is placed over one or two heating units. When a man stands on the plate a current of warm air is released and flows over it.

The outer casing of each unit is of steel, while the heating element is wound flat inside. To insulate the element from this casing, layers of mica completely inclose it. Each unit is capable of being used on either alternating or direct current. When it is desired to use a number of them, they are connected in a circuit.

This is not a newfangled ruler, but an efficient electric stove for outdoor workers



Built Like a Racing Yacht of the Air

The military airplane of to-day looks extremely simple from a distance, but at close range it proves to be a most intricate piece of mechanism. The drawing shows the fuselage of a two-seated German *Albatros*, which was captured almost intact a short time ago. It is a powerful machine of high speed, great endurance, and quick in maneuvering. Its Mercedes engine develops 220 horsepower.

The *Albatros* represents a highly developed universal military type of airplane, and is equally satisfactory for reconnoitering, artillery control, and bomb-throwing. It can even fight when hard pressed. It owes its superiority to the infinite care with which it is designed. It is built like a racing yacht. Light of weight, but made of strong material, its smooth surface and stream-lined form offer the least possible resistance to the air. To reduce head resistance, the radiator has been built in between the ribs of the upper plane, and the water-pipe is conducted down one of the slanting braces.

There are no abrupt curves. Everything has been carefully avoided that would in the least increase the head resistance or in any way disturb the equilibrium and diminish the maneuvering ability of the airplane.

An industrial locomotive that can haul twenty tons. The power is transmitted to the rear wheels only

Here Comes the New Ford Motor Locomotive

BASED on the Ford farm tractor, a new narrow-gage industrial locomotive now being experimented with by Henry Ford, is capable of hauling from ten to twenty tons in small dump-cars. The motive power of the apparatus is the same as in the Ford farm tractor and differs from it only in the employment of steel disk flanged wheels instead of the large cleated ones for negotiating soft ground. The machine is also driven on all four wheels, although the power is transmitted directly to the rear wheels only.

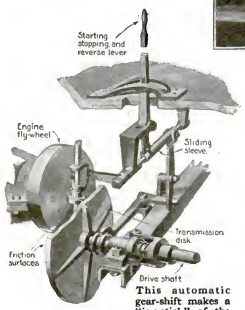
While not yet in commercial form, the machine has great possibilities because of its low cost of operation with kerosene as fuel, and by its adaptability to practically all work in which similar steam equipment is used.

Here's an Automatic Gear-Shift

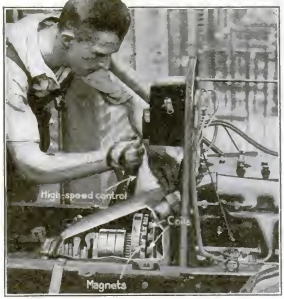
A NEW gear-shifting device shown below has a leather-faced small friction wheel, controlled by a lever, which is placed at right angles between the fly-wheel and the disk of the drive-shaft.

The nearer the small disk is moved to the center of the fly-wheel, the less speed will it transmit to the drive-shaft; the nearer to the periphery of the fly-wheel, the greater the speed transmitted.

The same lever throws the disk of the drive-shaft out of contact with the intermediate disk, thus stopping the car.



This automatic gear-shift makes a "joy-stick" of the control lever



Correcting space between magneto and coils to get a strong spark

To Start Ford Cars in Winter

SOMETIMES the difficulty in starting a Ford car in cold weather may be due to a too great distance between the fly-wheel, the magnetos and the coils, caused by a wearing away of the ends of the main engine bearings. To give an ample-sized spark, the magnetos, which are mounted on the fly-wheel, should be about three thirty-seconds of an inch away from the coils on the engine.

To start the engine, the car is put in high gear, with one rear wheel jacked up. Putting the car in high speed pushes the transmission assembly forward and closes up the space.

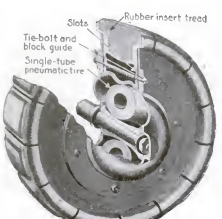
Putting the Wheel Around the Tire

NO one needs to be told the disadvantage of the pneumatic tire, especially the pneumatic tire used on motor-trucks. A Chicago inventor, Edward A. Banschbach, flashes this idea on us:

Why not make the hub a pneumatic tube, and put the wheel around it? You get all the advantage of the air cushion, save material and labor, and prevent much of the wear and tear, argues the inventor.

The wheel is made in segments. Around the axle-bushing a small, heavy pneumatic tube is mounted. Then the segments of the wheel are bolted in place.

For a tread Banschbach uses blocks of solid rubber, so that, when repairs are necessary, you remove, not the entire tread, but only the worn-out block.



Why not put the pneumatic tire in the center and the wheel around it?

A glance at the dial will show how many gallons are in the tank

Fill the Tank and Watch the Dial

WITH a new device owners of Fords need not remove the tank-cap to learn how much gasoline is in the tank. It is screwed into the opening usually covered by the cap. Two rods extend from the top member of the device to the bottom of the tank.

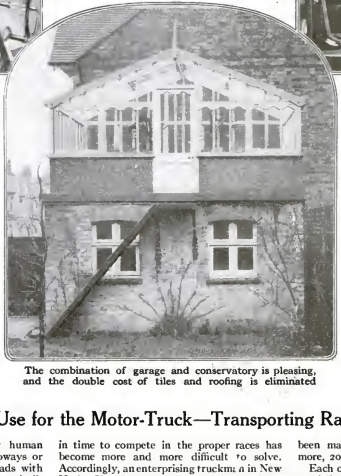
A cylindrical float slides along these rods as the level of the gasoline rises or falls. A third rod, with a screw twist, passes through a hole with a corresponding twist in the float, and receives a turning motion.

The upper end is connected with a needle which indicates on a dial the number of gallons in the tank.

An Economical Garage and Greenhouse

WHY not build a conservatory over your garage? This is practicable if the floor of the conservatory is made water-tight. If the garage is an addition to the house the conservatory can be entered from the second floor.

The same principle may be applied when the garage is a separate building. The greenhouse could then be reached by an outside stairs. The cost is not much more than that of the garage alone.



The combination of garage and conservatory is pleasing, and the double cost of tiles and roofing is eliminated

With this device you can prime the cylinders without leaving your seat

A New Spark-Plug Primer

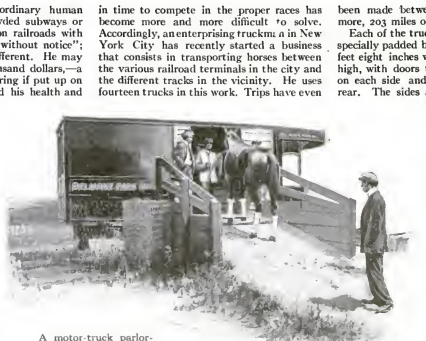
WITH the device shown above the priming of all of the engine cylinders is accomplished at one time. This is done by suspending a small gasoline supply tank from the rod holding the engine hood and running between the radiator and the dash, and by leading a pipe to a header connecting all of the priming cup valves. The valves are connected by means of short arms pivoted to a bar which is moved back to open the valves by the wire leading to the dashboard.

A stop-cock is provided to shut off the supply. A spring in the valve-bar automatically closes the valves when the wire is released.

A Novel Use for the Motor-Truck—Transporting Race-Horses

IT'S all very well for ordinary human beings to travel in crowded subways or try to keep appointments on railroads with schedules "subject to change without notice"; but with a race-horse it's different. He may be worth forty or fifty thousand dollars,—a sum that few of us would bring if put up on the auctioneer's block,—and his health and time are matters for serious consideration. Anything that will insure his getting from one race-track to another in good condition and on time means dollars in the owner's pockets and worry off his mind.

In the old days, track stars traveled between meetings in box-cars *de luxe*, with a special valet to look after their comfort; but with the many tie-ups that have occurred on the railroads, especially in the early spring and late fall meetings, the problem of getting the horses between racing tracks in safety and in time to compete in the proper races has become more and more difficult to solve. Accordingly, an enterprising truckman in New York City has recently started a business that consists in transporting horses between the various railroad terminals in the city and the different tracks in the vicinity. He uses fourteen trucks in this work. Trips have even been made between New York and Baltimore, 203 miles one way.



A motor-truck parlor-car for race-horses

Each of the trucks carries three horses in a specially padded body, fourteen feet long, five feet eight inches wide, and six feet six inches high, with doors three feet six inches wide on each side and a full-width door at the rear. The sides and rear end fold down to serve as runways to the truck, so that the horses can enter the bodies themselves. The trucks are equipped with large-sized pneumatic tires for greater speed and in order that their high-strung passengers may not be jolted on the way.

It's nice to know that even we mere humans may share their comforts. We can hardly hope to have a car all to ourselves; but the growing use of motor-trucks to relieve congestion on the railroads promises us many advantages—among them cheaper food—unknown to a motorless age.

Two Wars for Liberty—From

Until the present conflict drenched a more than half a century ago was the

Those who think that President Wilson has assumed too much authority would do well to read how "Old Abe" practically conducted the Civil War himself. There are some stiff letters of bis, written after inspections of camps, to generals with whom he was anything but satisfied. Here is "Old Abe" after a review at a Civil War camp, with a Pinkerton man on one side and Major-General McClernand on the other

There was no Y. M. C. A. in the Civil War, that hustling body having been organized after the great conflict. But some attempt was made to minister to the spiritual and physical comfort of the Union troops by the United States Christian Commission. We take it from the picture at the right that there were no huts, no places where refreshments were sold — nothing but tents and kind hearts

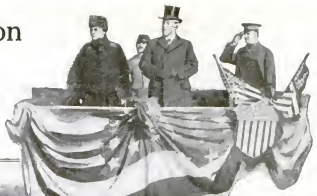
They had their huge camps in the Civil War, too. But compare these little log huts of 1864, erected at the Rappahannock Station, with the splendidly equipped, even sumptuous cantonments of 1918. War has become more luxurious as well as more terrible—a conflict of showerbaths, running water, good cooking, and warm beds

Mortars? Why, they had 'em in the Civil War. Look at this one, which was mounted before Petersburg, Virginia, in August, 1864. It fired old-fashioned gunpowder and round balls, and was a mere toy compared with the corresponding weapons that the Allies are now using

And big guns, too! The boys in blue and gray knew them well, and even to the fighting man of 1918 there is a businesslike look to this wide-mouthed cannon. It was the invention of the modern slow burning smokeless powder that made it necessary to abandon this type of weapon

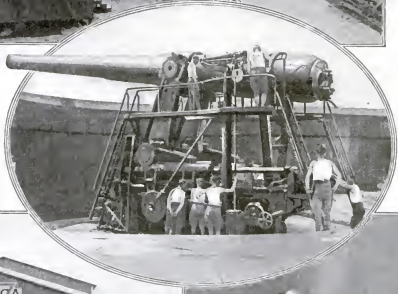
"Old Abe" to Woodrow Wilson

world with blood our Civil War of greatest struggle men had ever known



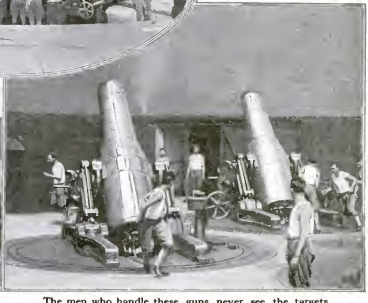
He cannot visit the battlefields as Lincoln did in his time, because the fighting is done thousands of miles away from Washington. But he can appear before his fellow citizens, from time to time, and make articulate the sentiments that long to be expressed in the breasts of one hundred million Americans

The cantonments of 1918 are bigger and roomier than the little huts of the Civil War. They were built, too, in record-breaking time by efficiency methods that were utterly unknown fifty-four years ago. In a few weeks provision was made at a single camp for housing forty thousand men—with sewer, shower-baths, and laundries



How different from the big guns of the Civil War! This 12-inch piece at the left is the type to be found in our coast defense batteries. It can hit a hostile ship ten miles away, and then drop back behind the parapet on its disappearing carriage. Army officers call this the Buffington-Crozier disappearing mount

They had nothing like it in the Civil War. Hundreds of thousands will come back from France with a new affection for the Y. M. C. A., and a new realization of its significance

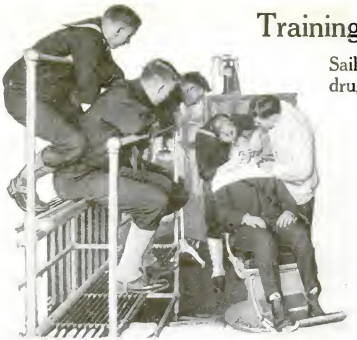


The men who handle these guns never see the targets at which they are firing; for the mortars of 1918 are mounted in pits. But they hit the mark just the same

Training the Navy Hospital Corps

Sailors who are going to be doctors, druggists, and dentists after the war

By Willard Connely, U.S.N.



The navy student who is extracting a confiding civilian's aching tooth is at the same time receiving instruction from the oral surgeon

WITH the mobilization of American resources for the war impact comes a natural feeling to most young men that they would like to serve in positions that they are qualified to fill. Others, not "stars" at any particular craft, have a natural aptitude for occupations which they are not called on to pursue in civil life. Both types are needed.

What the University of Minnesota Is Doing

The Navy Hospital Corps invites drug clerks, fledgling students in pharmacy, dentistry, or medicine, beach lifeguards, and those who have done first-aid work for hospitals; but enthusiastic inexperienced men are by no means denied a chance.

At the United States Naval Training Schools in Minneapolis, under Commander Warren J. Terhune, U.S.N., some of the instruction is carried on in the medical and dental colleges of the University of Minnesota. In that institution one hundred hospital apprentices are schooled every four months for the rating of pharmacist's mate. After completing their studies these men are transferred to duty in naval hospitals on the Atlantic coast, to hospital ships, or to the fleets, for immediate service in the sick-bay.

What will many of these corpsmen do when the war is over? If they return to civilian pursuits, they will study to become physicians, pharmacists, dentists. And for their future professional careers they will have to thank the United States Navy.

The course starts with lectures, mainly. The instructing nurses at the university hospital do not want the blue-jackets experimenting with convalescent patients until they appreciate what nursing means. So, in the beginning, there are talks and demonstrations in anatomy, pharmacology, physiology and hygiene, minor surgery, and bacteriology. Work in the laboratories and clinics, practice in dentistry, bandaging, and cooking for invalids take up nearly all the afternoons in the first month, after which they are continued in shorter courses because of the daily instruction in practical nursing. Later, too, the men receive instruction in physiologic chemistry, pathology, and therapeutics.

In order to set forth comprehensively a review of the training in general, it may be well to touch upon the salient topics in each subject. Anatomy—to medical study what copper is to electricity—is begun with the aid of skeletons, charts, and wax models from life. Once a week the sailors go into the dissecting rooms. No danger of forgetting what they learn there! The principal headings covered during the semester are *tissues, joints, muscles, arterial distribution, respiratory system, alimentary canal, skin, nervous system, special sense organs.*

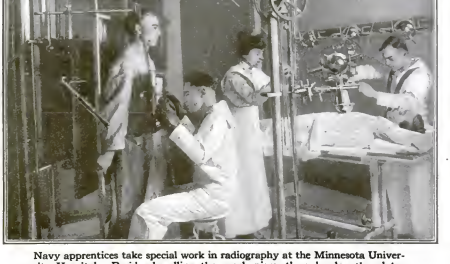
Here, for example, is a specimen exercise in the laboratory for pharmacology, which also covers chemistry, therapeutics, and materia medica:

> Put drop of cocaine on tongue. Try taste, with salt solution, acetic acid, quinine. Test cocainized area with head and point of pin. Boil a one per cent cocaine solution in teaspoon. Inject in arm. Test sensation with head of pin (pressure) and point of pin (pain). Test by applying hot and cold test-tubes against area. Repeat with one tenth per cent cocaine in nine tenths per cent salt solution (Schleich's pressure anesthesia). Boil cocaine for half an hour and repeat the tests.

How the Navy Students Practise on Each Other

General anesthesia is also taught. Other headings are antiseptics (including the Carrel-Dakin and dichloramine treatments made famous at the front), purgatives, soporifics, sedatives, salicylates, mercury, and the routine pharmacal methods of making liquid mixtures, powders, tablets, pills, salves.

No sooner had the sailors begun their bacteriologic exercises in the laboratory than they began to take nose and throat swabs of one another. If a blue-jacket finds his mate is harboring a few million more streptococci than himself, he takes consummate pride in heralding the doleful news. Teaching a man to make a culture of



Navy apprentices take special work in radiography at the Minnesota University Hospital. Besides handling the mechanism, they develop the plates

the diphtheria bacillus, to stain a specimen with methylene blue, or to learn to distinguish between pseudo-diphtheria (the pink-eye infection) and the real disease, infallibly rouses his latent inquisitiveness and zeal to learn. Further important details that the corpsmen learn in this class cover transmission of infection by contact, food and water, insects, and coughing. Of course, he learns all about disinfectants, and the bacteriologic examination of water and milk.

Allied to this course is much of the work in dentistry, new to hospital corpsmen, and therefore all the more fascinating. Says one of the professors:

> The gospel of the clean mouth will help win the war. A clean mouth holds within it from three to five million bacteria; an unhealthy mouth from six hundred to eight hundred million. In the latter case, the man at the front who sustains an injured jaw does not live. There's the difference, and the importance of it.
>
> Again, if it's rough weather at sea, decks awash and lots of hard work to do, and a man allows himself to get a chill, what happens? The pneumococci alway present in the mouth get busy and multiply, and the man finds himself in the sickbay. How can he avoid that? By using the toothbrush hard, not while he counts ten, but for five minutes by the clock.

Medical and Dental Help in Cases of Emergency

In oral hygiene the apprentices study gum inflammation and pyorrhea, decay, hygienic diet, and systemic disease (heart, kidney, joint, and stomach troubles) whose source is diseased teeth. They then clean one another's teeth in dental chairs. Finally, they examine civilian patients. For dental anatomy each man takes a rubber impression of his own jaws, makes from it a plaster cast, and mounts this work of art on a wire for study. A man will always study with eagerness a part of himself.

Next the sailors model jaws in clay, in which they insert the thirty-two teeth, selected one by one from a miscellaneous trayful. The last job is to cut longitudinal- and cross-sections of teeth, for anatomical observation of enamel, dentine, and root canals. This work leads up to operative dentistry, or filling, in which instructors take small groups of

It is not surprising that some of the men want to specialize in dietetics

blue-jackets and show them how to prepare small cavities, to fill with cement or amalgam.

With this modicum of instruction the corpsmen can at least lend temporary relief to their mates at sea, can save many a tooth which does not require extraction. In the art of tooth-pulling after novocaine anesthesia, the sailors are trained for fully two months. A wealth of civilian clinical material affords a variety of practice.

The hospital work is in three parts: bandaging, dietetics, and nursing. The course in invalid cookery comprises instruction in the preparation of liquid, semi-solid, light, and general diets. In sections of twenty, each man has his stove, materials, and "tools." Liquid foods comprize albumenized, acid and farinaceous beverages, as well as junket, ice cream, and broth; semi-solids include cereals, cream sauces and soups, eggs, and desserts. Light diet means fish, chops, baked potatos, and baked fruits. As for general diet—everybody knows what that is. But the king of the menu may be said to be steak. For popularity this course in which its preparation is taught, is the super-ace.

Nursing includes bed-making with the patient, bed bath, shampoo, computing and administering hypodermics, application of all sorts of compresses, irrigation of eye, ear, throat, and nose.

New Impulses that the War is Awakening

The advanced work in the latter half of the course is given over largely to operating-room practice, when the men help the surgeons, prepare patients for the operating table, and run the sterilizers and tanks. Part of this phase is intensive work in the X-ray room.

After such a broad introduction to the study of medicine, it is hardly to be wondered at that so many of the hospital corpsmen, as soon as their first cruise is up, indicate a desire to return to college and get their professional degrees. The war is awakening in thousands the simple urge to use their lives to better advantage. No brighter chance beckons than the free training in the Hospital Corps of the Navy.

A quiz in ear and eye irrigations, in which various members of the class are showing what they have learned

Learning to make flaxseed poultices and mustard plasters

Receiving instruction at the dispensary: in the nose and throat clinic

Photograph by Paul Thompson

Not Even a Chorus Girl Could Eat Him

THE Bureau of Fisheries says that we demand more lobster than our waters produce. This difficulty will be overcome if all lobsters will kindly grow as large as the one shown here.

This enormous fellow, weighing nearly thirty pounds, was caught off Boston and brought in on a fishing schooner. His advent into that quiet town caused much excitement, for he was the largest lobster that Boston ever saw.

The "Wrens" Are in the Navy

SO successful have the "Waacs"—members of Women's Army Auxiliary Corps—proved behind the lines in France, that the British Navy has brought into being a similar organization on its own account: the Women's Royal English Naval Service, known familiarly as the "Wrens."

Like their military sisters, the Wrens are to serve in the second line—in harbors, manning utility and messenger boats, at aerial bases.

They receive training first on model ships like the one in the photograph below—platforms on wheels, responding to the movements of a full-sized wheel and equipped with complete steering apparatus.

This Check-Book a Good Traveling Companion

THE ordinary check-book—the long and narrow one that lay open nicely on your desk, but bulked too large for your pocket and fell out easily—is responsible for much profanity on the part of travelers. So there is an element of moral uplift in a new kind recently distributed by a trust company in New York.

It is a check-book in the form of a four-by-three-inch leather wallet containing eight tabloid checks. It opens easily, delivering the checks without heavy creases.

How the Germans Blow Up Roadways

EVERY time the Germans retreat, the advancing Allies find a new and entirely unfamiliar array of destructive weapons which the Germans have not had time to take along. Their latest are iron tubes with spikes on the end.

Here (below) we see two British soldiers looking over some which they found in a newly captured town. The Germans use them in blowing up roads.

After they have backed out of a village the Germans drive these tubes into the ground, spike-end first. Then they fill them up with dynamite and time them to go off at the, to the German mind, right moment. (It's strange how these German inventions affect our English.)

British official photograph

A Really Obliging Obstacle

OUR old friend the traffic regulation post reappears, its former rigidity of manner smoothed by the inventive hand of J. H. Lehmann, of Elkhart, Indiana. Equipped with a strong coil spring in its base, this post, struck by the careless automobile, will bow an apology, prostrate itself on the ground to avoid injuring its assailant's radiator, and a moment later spring back erect, on duty again.

Nor is this complaisance its only feature. An unbreakable globe at the top of the post contains an electric bulb to make the warning visible at night, and an electric gong. Operated like the light from some central point, this gong will summon patrolmen, or give warning when fire apparatus needs a clear street.

British official photograph;
© Underwood & Underwood

Cow Moves Out for British Gun

THE necessity of protecting guns as much as possible from enemy aviators has stimulated the ingenuity of the Allied forces on the western front in finding unusual places of concealment for their guns or in camouflaging them so as to defy detection by the keenest observer.

The picture above shows a British field-gun securely tucked away in one of the few cow-sheds that escaped the ceaseless bombardment by German guns. It will speak well for the solidity of French cow-shed architecture if this structure remains standing after a few shots have been fired from the gun.

Gungha Dhin in Flanders

LIKE many another character sung by Kipling, the regimental water-carrier has glanced at the new armies, shaken his head, and decided that he might as well take to machinery. At present the Allied fronts have a water-supply as efficient as the most progressive municipalities.

Reserve, munitions, and supply camps well back of the lines, of course, have permanent water-works, in many cases erected specially by the Engineers. On the front itself, where the constant fluctuation of battle makes permanent works impossible, the supply is maintained just as effectively by mobile units.

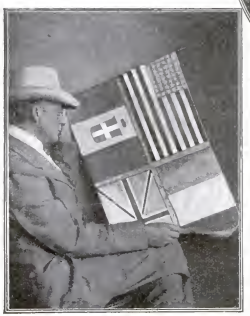
These units are trains, manned by specially enlisted experts, that ply between the nearest water-works and the rail-head near the front lines. Each train is a miniature water-works, entirely self-contained, and equipped with all the facilities for filtering, sterilizing, and distributing possessed by non-mobile water-works.

Each unit carries a chemist, a bacteriologist, a pump-man, and an expert staff of assistants for the laboratory on board; and tests are made every two hours.

The photograph above shows the installation of a temporary trough for the cavalry.

Here Is a Real Victory Flag

WHILE the piratical skull and cross-bones might appropriately serve as an ensign for the Central Powers, there is as yet no Allied flag. Louis Klebba, of Chicago, has designed the one shown below, which he thinks would look well at the dictating end of the peace table when the war is over. Quite properly, from the this-side-the-water point of view, the Stars and Stripes dominate the design, with the tri-color of France as a close neighbor on one side and the Italian man-of-war ensign on the other, while in a proper cousinly position appears the Union Jack of Great Britain.



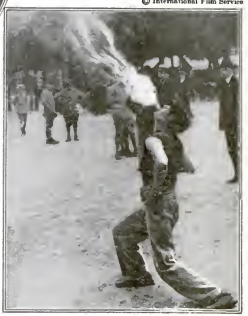
© Publishers' Photo Service

Fire-Eaters! They're Quite Harmless

THE fire king shown below is what is known as a "living gas-jet." He first shows his mouth empty, then takes a lighted match and holds it about six inches from his mouth. He then blows upon the flame, and his breath takes fire.

The explanation of this puzzling performance is simple. The performer secretes about his person a small sponge saturated with gasoline, which he surreptitiously introduces into his mouth. When he blows upon the match, his breath takes fire. The performer must close his lips immediately after exhaling.

© International Film Service



Hope for Humpty-Dumpty

SOME men's requirements for success in life are large. All that Mr. M. Mita, late of Japan, demands is all the pieces and time. Then he guarantees to neutralize the effects even of hammers on the most delicate of chinaware.

The art in which he has become celebrated is the repairing of costly vases: which calls forth his skill as an antiquary, a sculptor, a solver of jig-saw puzzles, and an expert in the practical science of cohesion.

The photograph shows him restoring a thirteenth-century Chinese vase whose pieces represent three thousand twentieth-century dollars.

If it rained everywhere as it does at Cherra Punji, the water would be over the Woolworth Building in twenty years, and Mount Everest would be submerged in 760 years

The Wettest Place on Earth

OF course the very bottom of the Pacific Ocean (approximately six miles below its surface) is an exceedingly wet spot; but the "wettest place" upon earth, according to the usual meaning of this term, is Cherra Punji, in the Khasia Hills of Assam, India. Here the annual rainfall averages 458 inches, or about 38 feet. This annual average is from January to January; but during the summer months Cherra Punji is deluged with about 300 inches of rain. This is a summer average of over 3 inches per day, but more than 30 inches per day have been recorded for five successive days, approximately 150 inches falling in 120 hours. Thirty inches in one day would certainly be more than enough rain for any place on earth, except the Sahara Desert, where the rainfall is zero; but almost 41 inches descended upon Cherra Punji during June 14, 1876. And in the year of 1861 more than 900 inches, or about 75 feet, of rain fell there.

The star shows the wettest place on earth

Now, let us see what the average annual rainfall upon Cherra Punji really means. The nearest approach to its 458 inches is at Maranham (277 inches), while at Vera Cruz 180 inches have been recorded. As for New York City, that has about 45 inches yearly, or about one tenth of the rainfall at Cherra Punji.

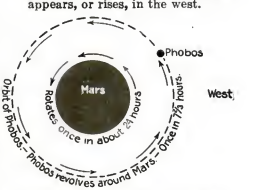
If the average annual rainfall all over the world for the past two thousand years has approximated 50 inches—this yearly average has been variously estimated — then since the beginning of the Christian era there has fallen from the clouds an amount of water not far from 100,000 inches in depth, or what would be equal to about 8,000 feet—that is, about one and one half miles. And supposing that, instead of an average yearly rainfall of 50 inches, there should have fallen from the clouds 458 inches, then the land-surface of our world—had all this water remained upon it—would have been covered by an ocean some 70,000 feet in depth. In other words, this land-ocean would have extended approximately 8 miles above the 29,000-foot summit of Mt. Everest in Asia.

Certainly Cherra Punji deserves the title of the "wettest place."

Mars Has a Moon that Sets in the East

OUR own moon rises, of course, in the east and sets in the west. So do all the other moons belonging to the other planets, except one of the two moons of Mars. This peculiar Martian satellite, named Phobos, rises in the west and sets in the east.

This seems very mysterious until we are told that Phobos travels around Mars faster than Mars rotates. That is, Phobos is revolving toward Mars' eastern horizon faster than Mars is rotating eastwardly, and therefore Phobos disappears, or sets, presently in the east, and reappears, or rises, in the west.



How Phobos, speed demon among the moons, outpaces Mars and rises in the west

How Far Off Is That German Gun?

How sixty-three German guns were located by sound waves alone in a single day

By Frank Parker Stockbridge

BY the use of "receiving stations" behind the lines, British and French military observers have been able to locate hundreds of German guns through the application of the science of acoustics. These stations are placed behind the Allied lines at points accurately determined, with the distance from each station to all others carefully recorded.

A receiving station may be nothing more than a microphone receiver concealed under a rock. The receiver is connected by wire to a central station with which the other stations are also connected. A simple clockwork device in the central station records the exact instant at which every sound is received at each receiving station.

How the Sound-Waves Are Calculated

The first sound is that of the shell passing overhead, since the projectile fired by a high-power rifled cannon travels faster than the speed of sound, which is normally 1,123 feet a second, varying, however, with wind velocity and direction and the temperature and density of the air. The next sound recorded is the "boom" of the gun, and then comes the sound of the exploding shell.

Careful corrections are worked out to allow for variation in the speed of the sound-waves due to atmospheric conditions. Then the difference in time at which the same sound was recorded from the different receiving stations is compared with the known distance from station to station.

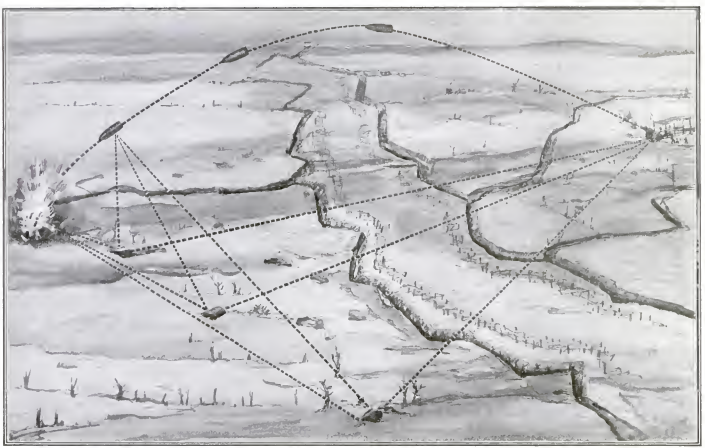
If, for example, the time when the sound made by a passing shell reaches Station 4 is 9:12:26, and the same sound is recorded from Station 5 at 9:12:27 and from Station 6 at 9:12:27½, it is a simple matter to determine that the point of origin of the sound is 1,086 feet farther from Station 5 than from Station 4, and 543 feet farther from Station 6 than from Station 5. With the known distances between the station as base lines, triangulation on a large-scale map, involving intricate calculations, provides valuable information as to distance, as indicated by the different times at which the same sound reached the different receiving stations.

The time records of the sound of the gun itself and of the exploding shell are also subjected to the same analysis; and, since it is obvious that the points from which the three different sounds originate must be in the same vertical plane, a straight line on the map connecting all three proves the accuracy of the computations.

Accuracy of the Method Demonstrated

So accurate has this method proved that in almost every instance, when the work of the observers at the central station (which may be miles away from the receiving stations) is compared with photographs made from airplanes, showing the position of the same guns, there is not room for separate pinpricks to indicate the results of the two sets of observations.

In one day, recently, sixty-three German guns were located by this means, and destroyed by airplane bombs, although many of them had been so successfully camouflaged that probably they never would have been discovered by any other means.



The sound of the passing shell, and later that of the gun itself, are noted by microphones, indicated in the foreground of the above picture at the ends of the dotted lines. The distances between the microphones being known, the difference in time noted for each sound forms the basis for calculating the direction of the shell and the distance of the gun

Twelve Niagaras in Our Automobile Horsepower

There are some 5,000,000 pleasure automobiles in the United States. The average horsepower is about 25. Hence, the combined horsepower that they generate is 125,000,000—twelve times as much as Niagara Falls. What that means is shown by the twelve Niagara Falls piled on top of one another in the picture at the right

Here is one of the power-houses at Niagara Falls. The water drops through a pipe against the blades of a turbine, or wheel, which is in turn connected with the generators. What an enormous power plant would be required if the 125,000,000 horsepower generated by the combined engines of all the automobiles in the United States were to be concentrated within a single structure

Gaze on the garbage-pail below. In twenty-nine large cities of America the refuse thrown into garbage-pails yields nitro-glycerine enough to form 200,000,000 twelve-ounce cakes of soap

New York garbage accumulates at the rate of 1,500 tons a day, or 547,500 tons a year. Of this huge amount only 700 tons a day are converted into useful products. A single ton of garbage will yield about 80 pounds of grease, from which 6 pounds of glycerine can be obtained. One ton of New York garbage yields enough glycerine to make the explosives required by fourteen 3-inch shells. Hence one day's garbage would amount to 21,000 three-inch shells—630,000 a month

Three hundred American cities are feeding garbage to hogs. They could produce better pork if the garbage were separated by the housewife

New York's garbage ought to yield about twenty barrels of alcohol (1,200 gallons) a day, or enough fertilizer to raise something like 12,000 bushels of wheat a day

Let Garbage Help to Win the War

Uncle Sam Goes a-Shopping

But he carefully tests everything that he buys

By A. M. Jungmann

This little instrument, a micrometer thickness tester, measures the thickness of a sheet of paper in thousandths of an inch

UNCLE SAM is a good military man because he is a good scientist. Nothing is too small to receive his careful attention, just as nothing is too big for him to tackle. He is as busy, these days, in his laboratories as he is in the field of war. He is working constantly to improve his military equipment. Whether the improvement is a new type of flying-machine or longer life for the luminous paint on the dial of a watch makes no difference to him.

The "Altitude Laboratory"

Among the many interesting laboratories Uncle Sam maintains at the Bureau of Standards in Washington is one that is unlike anything else in the world. It is the "altitude laboratory," and it is used for testing airplane engines. This laboratory is an air-tight chamber in which it is possible to simulate exactly the atmospheric conditions and temperatures of a fighting flight on the front. The behavior of any type of airplane engine may be studied for any height and temperature. Since the air pressure at various heights has a different effect on the fuel consumption, and as the temperature affects the lubricating oil, the great advantage of being able to study on the ground the changes brought about by these conditions is apparent. The thing can be done, in this latitude chamber, far more satisfactorily, accurately, and safely than in the air in actual flight. It is even possible to study the effect of sudden dives on carburetion, so rapidly may the atmospheric conditions be changed within the chamber.

In night flying our aviators must consult compasses and timepieces, just as they do in the daytime. We are all familiar now with watch dials that have luminous figures and hands that shine at night. Not only aviators but other members of our fighting forces have to be supplied with instruments that can be read in the dark.

Uncle Sam is not content with buying any one of the several luminescent materials on the market to apply to his instruments. He is making a complete and exhaustive study of the luminescent paints on the market. When he has finished his study he will know exactly how one luminescent substance compares with another; for he will have established standards of measurement.

How the weight of paper in pounds per ream is determined. The paper registers at five hundred times the actual weight of the sheet in the scale

How paper is inspected and tested to see if it complies with standard specifications. The machine tests a sample for its bursting strength by registering the pressure in pounds per square inch required to break the paper. The man using the microscope is examining the fiber composition of the paper

The instrument that determines the bursting strength of paper. It registers the pressure required to break the paper

The self-luminous materials which Uncle Sam is buying for war uses contain what are known as radio-active excitants. That is to say, they contain a substance that phosphoresces under the action of the radiations which proceed from radio-active substances and a small amount of radio-active material. The substance which becomes phosphorescent is called the phosphor, or the responsive material, and the radio-active material is called the excitant. The phosphor is greatly in excess of the excitant. In the brightest materials the proportions are about three parts of the excitant in ten thousand parts of the mixture.

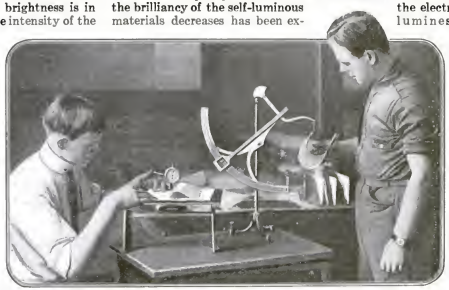
What Makes a Watch Luminous?

It may surprise you to know that the reason you can read that watch dial of yours at night is because the alpha radiations, which are helium atoms, each carrying a positive electric charge, are being constantly shot out at high velocities from the radio-active material and keep the phosphor in a state of continuous luminescence. Each time one of these atoms hits the phosphor, it lumineses. If you examine your luminous watch dial with the aid of a microscope, you will see that it twinkles instead of shining with a steady light.

This twinkling is caused by the bombardment of the alpha radiations. The greater the quantity of the excitant used, the steadier is the light of the material. When only a small quantity of the excitant is employed, the twinkling, or scintillation, may be seen readily.

A curious thing has been observed in regard to the luminescent material. Its initial brightness is in direct proportion to the intensity of the alpha-ray bombardment, but if the bombardment is continued long enough the phosphor will cease to luminesce. Therefore, if you take two samples of luminescent material, one containing a larger amount of excitant than the other, there will come a time when the one that contains the larger amount of excitant and was more brilliant in the beginning will decrease in brilliancy until it nearly matches the one having the lesser amount and the less brilliant at the start. If the two materials contain different phosphors, the sample that was more brilliant, and which contained the greater amount of the excitant, may ultimately become more dim than the one that was inferior in the beginning.

Observations made at the Bureau of Standards indicate that the life of self-luminous materials usually depends more upon the phosphor than it does upon the excitant. Some exceedingly brilliant material, which was said to contain only radium as the excitant, lost half of its strength of light in two months, although radium would require about seventeen hundred years to undergo as great a change. Phosphorescent zinc sulphide is generally used for the phosphor. The reason the brilliancy of the self-luminous materials decreases has been explained by the fact that the luminescence is due to the presence of small amounts of impurities in the zinc sulphide. These give rise to certain "active centers" of the material.



How the United States Government determines the weight of paper in pounds per ream and the thickness of a sheet of paper in thousandths of an inch. The sheet in the instrument registers a thickness of two thousandths of an inch. The weight of paper in the scale registers five hundred times the weight of the sheet, so one knows at a glance the weight of the ream

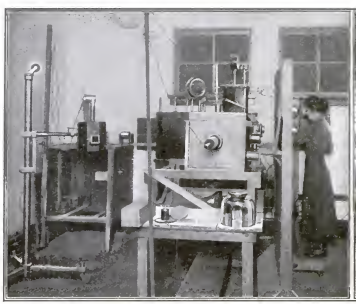
The Alpha Rays

During the bombardment of the phosphor by alpha rays, the "active centers" that lie in the path of the rays are subjected to violent electrical disturbances, which cause the centers to luminesce but also break them up so they are no longer "active centers." While there are enough "active centers" for the alpha rays to bombard, the luminescence persists; but as the bombardment continues, and the centers fall under the continued force of the electrical disturbances, the luminescence naturally decreases, because there are not enough centers remaining to give off the light.

What the Bureau is Doing for Radio-Telegraphy

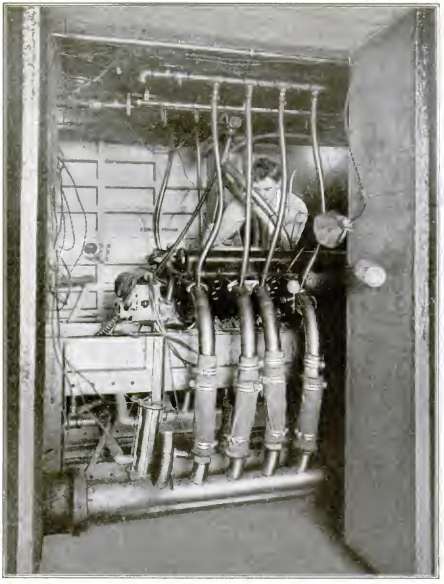
After the war it will be possible to write a most interesting history of the work now being done in the radio laboratory of the Bureau of Standards. Wireless is something that cannot be discussed as freely in wartime as in peace. The work of the laboratory consists of the testing of instruments and apparatus, giving technical assistance in wireless matters to branches of the government, the study of the theory and practice of wireless communication, and the maintenance of standards for radio measurements.

The Bureau of Standards also houses the United States radio-telegraphic laboratory and the laboratory that is maintained by the Signal Corps. The bureau tests wave meters, coils, condensers, ammeters, resistance measurements, insulating materials, and operating apparatus. If any branch of the government wants information on such subjects as the installing of transmitting and receiving equipment,



A scene in the X-ray laboratory. The X-ray tube is in the lead-covered box. Behind this you can see part of the apparatus for exciting the tube. Under the box is a shoe being radiographed. The photographic plate is under the shoe

Testing wall-board by immersing it in water. A sample four by six inches is placed in water for six hours. Every hour it is weighed. An increase in weight of not more than 110 per cent means that it is a properly moisture-proof wall-board



The altitude laboratory at the Bureau of Standards. Here an airplane engine can be tested under all atmospheric conditions, from the earth to 20,000 feet above it

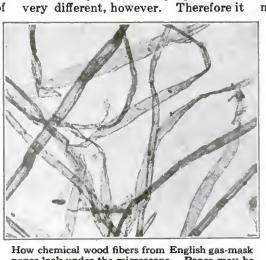
the efficiency of radio apparatus, the adjustment of equipment to comply with the law, the design of measuring instruments, formulae, or other data, all it has to do is to apply to the Bureau of Standards.

The radio laboratory also assists the government in the preparation of legislation for the regulation of radiotelegraphy. The bureau has designed complete radio transmitting and receiving sets which have been supplied to the government. Three were designed for the Department of Commerce, and are now in use.

Engineering Investigations

The research work which is going on is of inestimable military value. The investigations along these lines are of both a scientific and an engineering character. Naturally, we shall have to wait until the war is over before the results of this type of work can be given to the public.

Some very interesting tests have been carried on to determine the properties of such insulating materials as bakelite-dilecto, bakelite-micarta, and formica. As these three materials look very much alike, it is difficult to tell them apart. Their properties are very different, however. Therefore it is very easy for an unscrupulous person to sell an inferior grade for a superior one. But Uncle Sam will not be fooled.



How chemical wood fibers from English gas-mask paper look under the microscope. Paper may be made of rags, wood, cellulose, jute, manila or flax

Uncle Sam needs a lot of paper. In the government printing offices alone between 250,000 and 300,000 pounds of paper are used every day. Aside from that, tons of paper went into wall-boards for the cantonments which sprang up when we entered the war. All these varieties of paper must be up to standards set by Uncle Sam. Therefore a very busy laboratory is the paper laboratory of the Bureau of Standards, because every bit of paper used by the government must be tested before it is purchased.

Testing Paper for the Printer and the Builder

The testing of paper is divided into three parts: microscopical, physical, and chemical. When Uncle Sam gets through investigating a piece of paper by these three methods, he is in full possession of all its secrets. The use of the microscope will indicate to the experienced observer the kind of fibers in the paper—if several kinds, the proportion of the various fibers used; the presence of rosin size; the kinds of starches (these are indicated by the characteristic size and markings of the starch grains) and the kind of beating process used. For example, a light beating will fray out the ends of the fibers; heavy beating cuts the fibers without fraying out the ends.

By testing paper physically, it is possible to determine its tensile strength, folding endurance (how many times it may be folded without breaking), its bursting strength, and a number of other facts it is necessary to know if paper is to be bought intelligently.

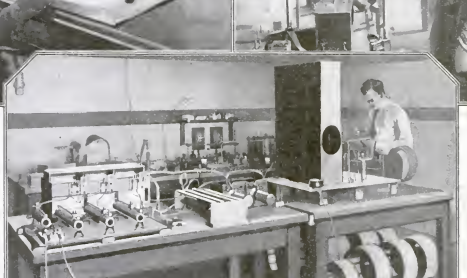
Finally, Uncle Sam decides to find out the percentage of ash the paper contains; how much paraffin it carries; what kinds of sizing, loading, and coating materials were used in it; and what chemicals were employed in its manufacture. He steps into his laboratory and sets to work to coax from it the last item of its life history.

The ash content is determined by burning a one-gram sample of paper and weighing the resulting ash. The percentage of paraffin is found by extracting the paraffin by means of gasoline or carbon tetrachloride. Other chemical tests employed in the paper laboratory vary from the simple to the complex.

In making the physical tests, a number of highly ingenious instruments are employed. There are several weighing instruments used for obtaining the weight of paper per ream—five hundred sheets. These generally weigh a single sheet, and an indicator gives the weight

This young woman is painting dials of watches and compasses with luminous paint, to make it possible to read them in the dark

Testing radium at the Bureau of Standards. Two strips of gold-leaf are hanging down, so that charges of electricity repel one another (both are positively charged). Radium has the power of taking off the electricity, or ironizing the air, making the air a conductor of electricity. This gradually causes the gold-leaf strips to come together. The rate at which they come together measures the radio-activity



Testing insulating material used in wireless equipment. Different kinds of bakelite look very much alike, without having at all the same properties

of the ream. If a sample of paper which is smaller than the regular commercial sheet is to be weighed, a chemical balance is used, and the weight in grams is multiplied by 1.102; this gives the equivalent weight, in pounds, of the five hundred sheets.

The test for determining the bursting strength of paper is carried out with the aid of water-pressure. The paper is clamped against a rubber diaphragm, through which the pressure is applied. Another instrument for measuring the bursting strength of paper is one in which the paper is clamped between rings through which a spring-operated plunger is forced.

The machine that records the folding endurance of paper takes the paper, which must be cut in a strip of a definite length and width, and folds it back and forth until it breaks. The number of times the strip is folded is recorded.

You may have observed that paper acts very differently on damp, rainy days and on dry, clear days. It will tear readily when the weather is humid, and it will be crisper and less apt to tear when the weather is fair. Since that is so, the physical tests of paper must be conducted under definite atmospheric conditions. The physical testing room in the paper laboratory at the Bureau of Standards maintains a fixed degree of humidity.

Houses Built of Paper

The use of paper for wall-boards has been found to be very successful in the building of cantonments. "Wall-board" means any material that takes the place of lath and plaster.

There are three classes of wall-boards: boards made of paper pulp—these are either homogeneous boards or laminated boards; boards made of plaster, gypsum, or similar material without the addition of wood pulp or like substances; and boards made of wood covered with paper.

The adhesive with which the laminated boards are fastened together is very important. The boards should be waterproof to a certain degree. Paint will not make a board waterproof, because if the adhesive is of such a nature that it will absorb water readily, water will seep in around the edges. To be satisfactory, boards should be sized with resin and alum. Before Uncle Sam buys boards for the walls of his cantonments he has them tested in his paper laboratory. If they have been properly sized and pasted together with great care, he buys them. If not, he refuses them. He is particular about the pasting because silicate of soda contains some caustic alkali which is likely to set up a chemical reaction with the resin size and reconvert it into a soluble form, thus admitting moisture. If water enters through the adhesive it will quickly spread through the board.

The importance of care in the selection of war materials may be better understood when one considers the quantities which have been bought since we entered the war. Here are a few items, selected at random, from Uncle Sam's vast shopping list: 27,276,000 pairs of shoes, 625,461,392 pounds of flour, 106,000 motor-trucks, 72,274,529 cans of tomatoes. All of these things are tested and inspected before they are accepted. Do you wonder that Uncle Sam is busy in his laboratories?

This excellent reproduction of a blue shark and her young can be seen at the American Museum of Natural History in New York City

A Clever Counterfeit of Nature

THE blue shark inhabits the open ocean and is seldom found near the coast. It abounds in that central portion of the Atlantic known as the Sargasso Sea.

The conditions under which the blue shark lives are most realistically reproduced in a wonderful group in the American Museum of Natural History, in New York, prepared by F. F. Horter under the direction of Major Bashford Dean, Curator of Fishes at the Museum. The group shows a female blue shark with her young.

The large shark is made of plaster, the small ones of wax. The weed is also of wax. A rope —a clever imitation—was introduced behind the big shark to give it support. The small sharks are suspended on wires of molybdenum. These wires are as thin as hair, yet they will support a weight of 8½ ounces.

An East Indian Fish that Shoots Its Prey

FISH are decidedly stupid-looking creatures. So renowned is this reputation that if you wished to insult a friend's intelligence you might call him a fish and be sure of being understood.

But looks are deceiving, for here is a keen, ambitious (withal stupid-looking) fish, called the "archer," having very up-to-date ideas about fighting and feeding. It simply shoots its victim—not with an incendiary bullet but with a well directed drop of water.

Mr. Archer, swimming along about lunch-time, sees a tender, juicy fly sitting on a branch about a foot from the surface of the water. He remains motionless for a moment, so his presence will not be suspected,

It is annihilating an unwary bug by shooting a drop of water at it

takes aim, and then fires a drop of water at the unsuspecting fly. The drop of water is fired from an opening in the fish's lower jaw, and travels with great force created by a contraction of the muscles in his mouth.

The drop is forced through the water into the air, and hits the fly amidship. The fly tumbles off into the water and is promptly eaten.

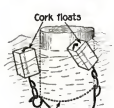
The illustration herewith shows the fish in the act of snaring a bug. Note the eager, intense look in his eye.

This curious shooting fish—whose scientific name is *Toxotes jaculator* — is found in the waters of East India. At flood tide there are always many of them near the mouths of rivers.

They travel either alone or in schools along the shore of sheltered bays where bugs are fond of congregating. Swimming near the surface of the water, they easily spot their victims.

Altogether, the archer's system is a good one, and it seems to be trying to live down the reputation of fish-kind.

Keeping Wharf Piles Free from Barnacles



WHERE organic life in the ocean is profuse, piles and other periodically submerged woodwork soon decay. The wooden bottoms of ships must frequently be scraped to protect them from barnacles, but with piles such precaution is rarely taken.

A California inventor, Alva L. Reynolds, of Long Beach, recently obtained a patent on a device for protecting piles against marine organisms on their surface. The device is extremely simple. Where tried, it has proved to be very effective. It consists of two semicircular sections of wire, looped together at their ends to form a ring, and placed around the pile. These rings should not fit tightly around the log, but should be loose enough to slide readily up and down.

To the rings, which connect and hold together the loops at the ends of the semicircular wires, floats are attached. These floats rise and fall with the tide, carrying the rings with them. The wires scrape along the sides of the piles and effectively prevent barnacles and other sea organisms from attaching themselves, growing fast, and becoming a source of danger.

Wire loops, which slide up and down the piles as the tide goes in and out, keep barnacles and other organisms from becoming permanent

Sleep Outside of Your Window for Your Health's Sake

SLEEPING out of doors is highly recommended by physicians for both children and adults; for, in spite of the most careful ventilation, the air of a room can never be as pure as the outside air. Sleeping out of doors is usually a simple matter for people living in the country; but in cities, and even in suburbs, it is not generally easy to arrange. This is particularly unfortunate because city dwellers need the tonic effects of pure air more than do people who live in the country.

The sleeping balcony invented by Mark H. Smith, of Lansing, Michigan, offers a practical solution of the fresh-air problem for those city dwellers and suburbanites who live in dwellings other than apartment-houses. His sleeping balcony consists of a cage-like frame structure open on one side, and with walls of latticed iron strips on the other three sides. Longitudinal sills at the bottom, braced by diagonal iron braces, support a spring mattress on which the bedding is placed.

Mark Smith invented it to solve the fresh-air problem of the city dweller

This cagelike balcony is suspended by means of hangers outside of a convenient window that gives access to the balcony. It is also supported by braces for additional security.

The roof of the balcony is formed by an awning which may be raised when desired. For greater privacy, and as a protection against rain and wind, a canvas screen is provided on the three open sides. This screen may be raised or lowered at will by the occupant of the sleeping balcony.

The framework of the balcony is in separate sections, which are bolted together when the structure is attached to the side of the house. This makes it easy to transport the balcony. It requires no special tools or great experience to put up one of these balconies.

What Makes It Go? Just Temperature Changes

ALL metals are influenced more or less by changes in temperature, expanding when the temperature rises, contracting when it falls. Zinc has an unusually high ratio of expansion and contraction. A strip of zinc one thousand feet long will expand about one inch every five degrees the temperature rises. The expansion and contraction of metals is transformed into motive power in thermal motors.

A Swiss clock which employs the expansion energy of zinc

In the thermal clock here shown, which was invented by Friedrich Bangerter, a citizen of Switzerland, the expansion energy of zinc is employed for driving a clock, and at the same time the excess energy produced is stored, to make it available for continuing the movement of the clock mechanism at other times.

Strips or bars of zinc of a total length of about one thousand feet are used in this thermal motor. The individual strips are about five feet long and are arranged to form an articulated helix. By an ingenious system of coil-levers, the effects of the expansion or contraction of the individual strips are compounded so that the total energy developed is equivalent to a force capable of lifting a load of one hundred pounds two inches. This force is sufficient to run the clock and to give a margin for storing the excess energy.

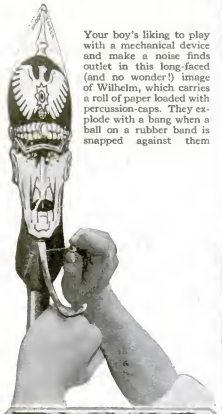
Keep a Fire-Escape Under the Window-Sill

CANVAS chutes make excellent fire-escapes, but the chute, with its many yards of canvas and its framework, must be stored near a window, and it is not very ornamental.

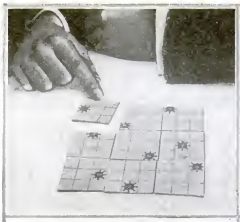
An invention recently patented by Henry L. Bartley, of Philadelphia, seems to solve the problem. It provides a recess, or chamber, in the wall below the line of the window-sill, in which the canvas chute, neatly folded up, is stowed away when not in use. An L-shaped cover hinged at the bottom of the recess completely conceals the recess when it is closed, the free end of the L forming part of the window-sill.

The chute consists of an elastic canvas tube of sufficient length to reach the ground, and wide enough to permit the body of an average person to slide through it. At its upper end it widens into a canvas funnel, the edge of which is securely fastened to a metal frame. By means of rods the frame holding the chute can be swung to the outer part of the window-sill at need.

When you smell smoke, throw the funnel out the window and slide down its interior



Your boy's liking to play with a mechanical device and make a noise finds outlet in this long-faced (and no wonder!) image of Wilhelm, which carries a roll of paper loaded with percussion-caps. They explode with a bang when a ball on a rubber band is snapped against them



There are 28 ways of placing the "guns" so that an attacking enemy must come under their fire

Getting the ten soldiers (metal balls) through the trenches and into the fort is guaranteed to try your patience

Getting this dreadnought out of dry-dock will exercise the budding blue jackets' wits. The smokestacks hold the secret

Pigs in clover? Not at all; it's transports and submarines these days, and the game is to get safely across the water and into port

The secret of how it opens is revealed only to the boy who wants to buy Thrift Stamps

War is a great geography teacher. The youngsters move men from "over here" through all the warring countries

If his aim is sure he'll hit the Kaiser, who drops out of sight while Uncle Sam pops up flourishing the victory flag

While their fathers fight their play is all of war

Why the War Office Had a Bad Nightmare

Win-the-war devices actually proposed to the British Ministry

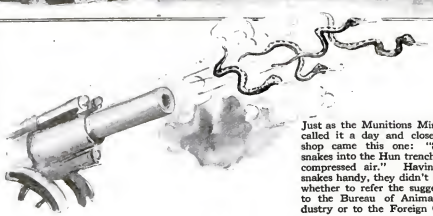
Inventive ingenuity is not confined to the Yankees, as was proved by the Britisher who suggested that buzzards be trained to fly to Essen and pick the mortar out of the Krupp chimneys

No more moonlight for Hun air raiders. What will they do to the moon? Why, just blot it out with a beam of "black light." And what is "black light"? Ask the inventor

One of the cranks of war turned up this one: "Build a cement gun to squirt cement over the Heinies and petrify them"

Equip a big shell with motor and steering gear, put a man in it, and tell him to drive

"Your suggestion will receive our earnest attention," read the note acknowledging the suggestion that it would be easy to freeze clouds and mount artillery on them from airplanes



Another patriot asked nothing for his idea of sending over the German lines a fleet of balloons carrying powerful magnets which would jerk the guns out of the enemy's hands and the tin hats from their heads

Just as the Munitions Ministry called it a day and closed up shop came this one: "Shoot snakes into the Hun trenches by compressed air." Having no snakes handy, they didn't know whether to refer the suggestion to the Bureau of Animal Industry or to the Foreign Office

Chemists use a draught-closet when they work with compounds that give off nauseous or poisonous fumes. Now the draught-closet is used in the kitchen to carry off cooking odors

A Kitchen that Lets No Guilty Smell Escape

WHEN the housewife boils ham or cabbage, everybody in the house knows it. If the cooking is done in the diminutive kitchenette of a modern apartment, a small edition of a German gas attack is very apt to be the result.

The architect who designed the model kitchen recently installed in Paris, solved the cooking-odor problem by borrowing an idea utilized for many years in all well equipped chemical laboratories. Many chemical operations are accompanied by disagreeable and often highly injurious fumes. Such operations are carried on in so-called draught-closets.

The draught-closet of the model kitchen is very similar in construction to the chemical draught-closet.

It has glass doors through which the progress of the cooking operations on the gas stove can be watched. A slit in the lower part of the glass doors admits air, and the heat, steam, smoke, and cooking odors escape through a flue placed in the upper part of the cabinet.

If the draught-closet in kitchen or kitchenette is properly constructed and provided with a good flue, it will prevent even the odor of corned beef and cabbage from penetrating into the living-rooms of the apartment.

Cooking Over the Stable Lantern

A WIRE cage that can be firmly affixed to the top of an ordinary stable lantern and used for cooking food, has been devised by David M. Kupihea of Honolulu. The cage can be applied without interfering with the construction of the lantern and can be taken off when it is not needed.

The cage is circular in form, the top being open and the bottom partly closed by means of wires bent into U-shaped fingers, which are arranged so that an opening is formed to permit the heat from the flame of the lantern to rise up and warm the pot resting in the cage. The side-bars of the lantern pass through spaces on each side of the cage and hold it in place. Thus, this efficient lamp can ably do two things at the same time, and so is very useful, now that conservation of fuel is the great war-cry.

And, speaking of conservation, doubtless the lantern device, with modifications, could be applied to the ordinary household lamp. This would enable folks to enjoy this new evidence of the inventiveness of Hawaii.

With this cage an ordinary lantern can be pressed into service as a fuel conserver

Using the Kerosene Lamp to Provide Warm Lunches

MODERN science has established the fact that cold lunches, as a rule, do not contain enough nourishment in an easily assimilable form to satisfy the needs of growing children. In many city schools hot lunches can be obtained, but in country schools children still depend upon cold lunches.

Claude B. Green, principal of the High School in Boydton, Virginia, has recently patented an invention which, in a simple and inexpensive way, solves the lunch problem. The invention consists of a double-walled cabinet lined with insulating material, heated by a blue-flame kerosene lamp.

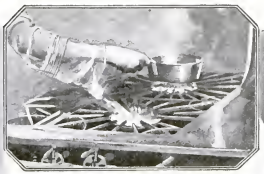
Wire racks inside of the cabinet supply shelves upon which the lunches are placed. Boxes of wire mesh form individual receptacles for the lunches, and are identified by numbers. Each box contains a solid compartment for soup, cocoa, or milk. The cover of the box is used as a drinking cup.

The heat generated by the lamp heats the interior of the cabinet, circulates between the double walls, and passes out through ventilating holes.

A Southern school principal invented this cabinet in order to provide warm lunches for his pupils.

Don't Blow Out the Gas

Don't search for the leak with a candle—call the plumber



Before you start the Welsh rabbit put on that becoming bungalow apron. Chiffon sleeves are really not safe near a gas stove

A frequent cause of fires—leaving the gas lighted near an open window

DON'T blow out the gas is good advice to remember this winter.

Don't allow a draft to blow out the light. A sudden gust of wind from an open window may do the trick, and you will wake up in eternity.

Don't hang clothes on gas fixtures. It is an easy way to start a leak.

Be sure to turn the gas off. Don't forget to see that your gas fixture is in good condition. See that the pin is properly placed so the key won't turn all the way around. If the key does turn all around, you are quite likely to turn the gas on again after you have turned it off. If there is anything the matter with your fixture, the gas company will repair it.

Many a leak has resulted from this unnatural use of the fixture

If you smell escaping gas, notify your gas company. Many persons have lost their lives through looking for a leak with a match or a candle.

If you feel you must locate that leak yourself, put a wet cloth over the place where you think gas is escaping. If the gas really is escaping, you will know it by the appearance of air bubbles.

Don't use inferior gas tubing.

Gas mantles are safer to use than is the open flame, because if you turn the gas off in a mantle-equipped fixture and then turn it on again in five seconds the gas will light. The use of gas mantles will prevent an accident through inadvertently turning the gas on again.

Don't allow curtains or draperies anywhere near an open flame.

You Can Make Burning Gasoline Absolutely Safe

IF ANYONE told you that you could pour gasoline into a burning tank of gasoline without any danger to yourself, you would tell that person he was crazy. Yet one of the accompanying illustrations shows a man pouring real gasoline through a real live sheet of flame flaring out from the top of a tube on an automobile gasoline tank, and another shows a young woman doing a similar stunt with a small gasoline tank on a camping stove.

These unusual and almost uncanny performances are made possible by inclosing the tube entering the tank with a fine wire mesh screen which prevents the burning flame at the mouth of the tube from passing down into the fuel in the tank.

It looks dangerous, but the safety tube is in place

But this is only one of three advantages of this safety tube. The other advantages are that the tank cannot explode, and that there is no evaporation of the gasoline.

This innocent-looking tube takes the danger out of gasoline in several ways

Since the flame cannot enter the tank, the only other thing that could make the tank explode would be the expansion of gases in the tank. The way to overcome this difficulty is to allow the gases to escape when the pressure gets too near the strength of the tank parts. This the safety tube does automatically.

As soon as the pressure in the tank reaches the danger mark, the gases press up through the small holes in the cap top and lift the tank pressure valve. When sufficient gases have passed off, the spring automatically seats the valve again.

Evaporation is prevented, notwithstanding that air must be admitted to the tank to take the place of the fuel drawn off as it is used.

The tube keeps the flame from getting to the fuel

Mechanical Aid and Comfort for

This service emblem can be attached to your radiator screen

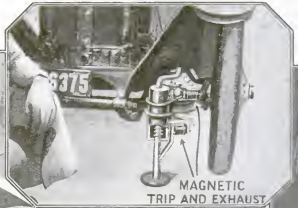
A cone clutch that is slipped off the hub for renewing the leather

A good fit is obtained by making the leather slightly longer than the brake-band

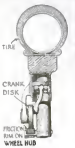
You can imagine how big must be the Italian howitzer that is to be mounted on the huge carriage hauled by this tractor. The carriage has a specially constructed steel frame and its four wheels have paddle-like treads which prevent them from sinking into muddy ground

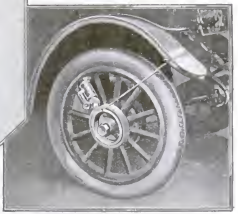
To cool the engine of the Ford, a centrifugal water-pump forces the water through the water-jacket, while a fan blows air through the radiator to cool the water before it is again pumped back in the cylinder-jackets. The pump and fan are separated by the motor crank-shaft

A new kind of solder comes in the form of a narrow tube with inside partitions containing an acid flux



Pushing a button on the control-board admits compressed air into the cylinder of the jack and raises the car by pushing down the piston. Pushing another button releases the ratchet, opens the exhaust valve, and lets down the car





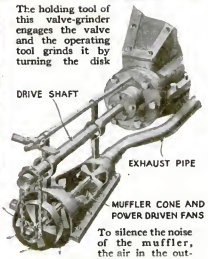
This tire-pump is mounted on the felloe and operated by an eccentric disk rotating against the surface of a band attached to the spokes and ordinarily rotating with them. To make it operative it is held by hooking it to the mud-guard

There seems to be no limit to the number of ways of utilizing an automobile. The truck in the picture above is jacked up in the rear and is used to hoist hay to the loft. The hub serves as the drum

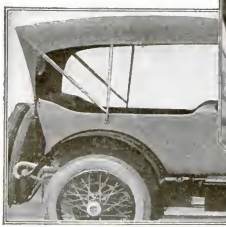
A miniature tank is an appropriate ornament for the radiator valve

The holding tool of this valve-grinder engages the valve and the operating tool grinds it by turning the disk

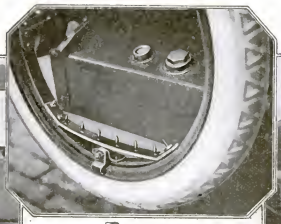
An enterprising company in Detroit has several Fords equipped like that in the picture, fitted up to sharpen knives and other tools on motor-driven grindstones



To silence the noise of the muffler, the air in the outlet cone is kept in motion by fans driven by the drive-shaft



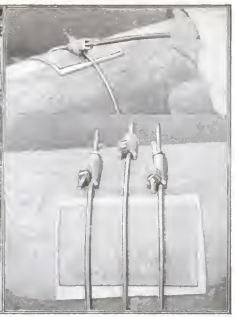
The ends of the top supports fit into key-hole sockets and are held tight by a cam when turned into position



A strip with spikes, fastened to the inside of the spare tire rim, prevents boys from "hitching on" to steal rides, a practice often leading to accidents

On an omnibus line in Seattle, Wash., the driver "rings up" the fares on an ordinary cash-register

Among labor-saving devices that help women to tackle men's jobs is this hand truck, which is unloaded by simply pressing a pedal



Householders were not inconvenienced in the least by this bit of plumbing

This New Truck Gets Under the Load and Lifts It

A NEW kind of hand truck for conveying heavy loads in manufacturing plants embodies several very ingenious features.

The truck, with the handle in a vertical position, is wheeled under the skid carrying the load. By pressing down a pedal near the front end of the truck, a hook link is raised to a position in which it engages in a notch at the lower end of the handle-bar. Then the handle is swung down, and by its lever action the platform of the truck is lifted so as to raise the skid with its load off the floor. A hook on the pedal engages a stud on the front cross-bar of the platform and holds it in its elevated position.

To lower the load, a slight pressure on the pedal is all that is required.

Patching the Water Main Without Turning Off the Water

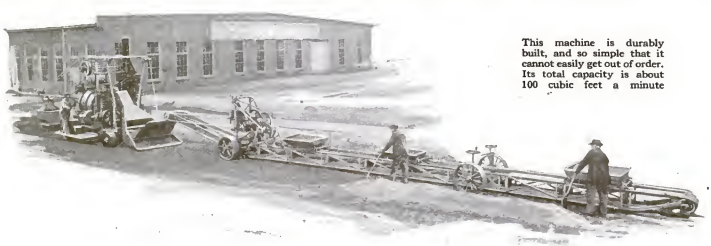
WHEN a leak in a water main occurs, it should be repaired promptly to prevent damage. The water must be turned off, the ground excavated to make the defective part of the pipe accessible, and then the leaky section is removed and a new section substituted for it. If the leak is small, it may be possible to stop it with a plug or a patch.

Here is a method of repairing such leaks without shutting off the the water. The earth is removed from the defective part, and a patch of sheet rubber placed directly over the leak and covered with a piece of 10-gage steel. The patch is held against the pipe by rods, the threaded ends of which pass through holes of a clamp and are drawn taut around the pipe by tightening nuts on the ends of the rods.

Machinery Aids in Labor Shortage

THE combined loader and mixer in the picture below offers the possibility of reducing the cost of road-building by better and more rapid work and by reducing the man power about two thirds.

It is a combination of measuring bins and the belt-conveyor principle applied to a light portable mixer run by a five-horsepower gasoline engine which also supplies the traction power. Its length is approximately sixty feet. The measuring bins are adjustable, and mounted on frames provided with wheels which run on a track on top of the loading frame. They can be moved along the whole length of the loading frame so as to bring them within convenient distance of the piles of sand or crushed stone. The material shoveled into the measuring bins is dropped on the conveying belt underneath the bins and carried to the mixer.



This machine is durably built, and so simple that it cannot easily get out of order. Its total capacity is about 100 cubic feet a minute

Butter from the Coal-Oil Cow

You've never seen a coal-oil cow, but you may hope to see one

By John Walker Harrington

THE village pump has long competed with Bossy. Now comes the derrick to substitute for the churn. For butter can be made from petroleum.

As yet, this artificial petroleum butter does not possess the desirable new grass taste; it savors more of the flavor of axle-grease. Dr. Gustave Egloff, a well known chemist who has been experimenting with it, does not recommend it for the table, or even for automobile luncheons by the wayside. But the day will dawn when the oil refinery will compete with the creamery.

A Problem for the Chemist

Petroleum is a highly complex liquid composed chiefly of hydrogen and carbon in chemical combination. Hence chemists call petroleum a "hydrocarbon." Many of our foods, including butter, are also combinations of hydrogen and carbon—but different. You can build with brick hundreds of houses that bear no architectural resemblance to one another; you can build up from hydrogen and carbon atoms thousands of substances as different as coal-tar dyes and potatoes.

So this problem of making good butter out of a vile oil that oozes from the earth resolves itself into a rearrangement of its atoms. That is not an easy problem; for petroleum is composed of some thirty different chemical compounds classed as hydro-carbons, and is impregnated, besides, with soluble nitrogen and sulphur. We have many hydro-carbons that are good to eat, such as the starch which is an important constituent of wheat and corn and potatoes.

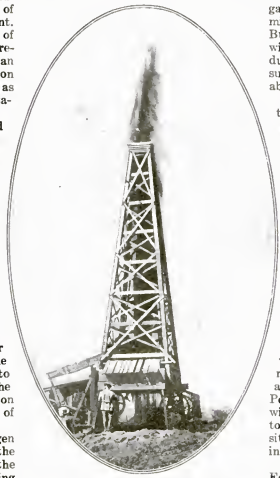
Butter is a solid fat consisting of a group of acids. Of these acids the principal one is called "butyric" acid. It is made by agitating or beating milk so as to break up the globules of fat and to bring them into a solid mass. The problem of the chemist is to change the hydro-carbon of petroleum into the pleasing acid of good creamery butter.

Hydro-carbons consist of hydrogen and carbon. The first step in the transformation is to "chlorinate" the petroleum. This is done by forcing chlorine into it by an electric current which is turned on while it is confined in a closed mixing vessel. The chlorine combines with atoms of hydrogen and produces hydrochloric acid and chlorides of the hydro-carbons.

It Looks All Right

Next this mixture is boiled with caustic soda, a chemical resulting from the union of hydrogen and soda, and technically known as a hydrate of that element. Chlorine reacts with soda and forms a chloride of soda which is common salt. Thus we have our derrick brand of butter literally salted in the making!

There is present in the mixture, also, a combination of the carbon, the hydrogen, and the oxygen, which have all been brought into new relations. They constitute a form of alcohol. By intricate chemical processes more oxygen is added, so that the compound is changed into a group of acids which may be assimilated by the human system exactly the same as are those fatty acids which we call butter.



Turning the oil from this "gusher" into butter for our bread is merely a matter of rearranging atoms

Dr. Egloff's early experiments were made with a light colored fuel-oil of the kind used under the boilers of ocean liners. This experimental butter had the proper yellow tint, but, owing to the fact that many things had not been eliminated from it, it had a taste that was far from palatable. By bleaching and filtration it is possible to obtain a bland, colorless, and tasteless petroleum. Such a product is now sold by every drug store as an internal lubricant.

When the chemist starts with a bright, pure oil, he can undoubtedly produce a most edible substitute for butter.

Butter substitutes are legion. The best known of them is the oleomargarine, which is a chemically pure mixture of animal oils and stearin. Butterine is oleomargarine flavored with real butter. Both of these products are made under government supervision, and are accepted as valuable foods.

Theoretically, the way is open for the production of a food adjunct of great economic value.

Chemistry in a Transition State

Industrial chemistry is in a state of transition. The impossible of the present becomes the inevitable of the future. It was only a short while ago that the molecule was regarded as indivisible; yet, in the chemistry of petroleum alone, this belief has been repeatedly shattered. By the "cracking" of molecules of kerosene, the supply of gasoline, in this country, has been appreciably increased.

By treating oils obtained from cotton-seed, cocoanuts, and peanuts, with hydrogen gas in the presence of nickel or iron, hard fats result which are acceptable substitutes for lard. Petroleum butter may take its place with these lard substitutes, and come to be regarded as a household necessity, while the bovine variety will pass into the list of luxuries.

There are very good reasons, as Dr. Egloff has pointed out, why the use of fats from petroleum will someday be considered a matter of prime importance.

French official photograph

See if You Can Hop through This, Fritz

TO be unexpectedly attacked at night is not relished by any soldier. The sound made by the enemy in cutting barbed-wire entanglements used to give timely warning against attack, but now there are ways of cutting wire noiselessly.

The French have a new scheme for Fritz when he "walks the night." They string up iron hoops in front of the trenches. Fritz must be agile enough to hop through or over these hoops if he is planning a surprise party.

He Is Coddling Cooties on His Arm

THIS is not a wrist-watch, but a home for friendless cooties. A pair of them are tenderly placed under the glass top of this wristlet. By watching the development of mother, father, children, and eggs, the patriotic landlord does his large-sized bit. As he is a bug specialist, he notes with full appreciation their characteristics and habits while they chew on him undisturbed. Then he reports his observation to the Bureau of Entomology.

Make Sunlight Your Alarm-Clock

HERE is an alarm that doesn't have to be set before going to bed. It is simply a mirror mounted on the sash of any bedroom window that catches the early morning light. As the sun rises the rays fall upon the mirror and are reflected into the sleeper's face. Usually the first few rays are sufficient to awaken one.

By a simple series of lead-pencil calibrations the mirror can be arranged to awaken the sleeper at any hour after sunrise.

Save Your Old Tin Cans

THE old-fashioned can-opener is doomed. After you have emptied the contents of a can, place the can in this new machine, turn the crank once, and you have a new can ready for next season. Next summer, when you have refilled the can, cover it with a new top, place it again in the machine, push the cutter back out of the way, lower the top, turn the crank once, and your can has a perfect seal.

Trapping the Hobo in the Box-Car

THE Southern Pacific Company has a box-car hobo-trap. It is simply an ordinary box-car with an electrical device to indicate when hoboes enter, and an arrangement by which the door is closed and locked.

To make the trap especially inviting its floor is covered to a depth of five or six inches with straw. The side doors are left open. No sooner does the hobo lay him down to sleep, when a tiny ruby lamp in a box on the roof flares up. The light is visible from the caboose and from the locomotive tender. The brakeman goes over the train to the roof of the trap car, and pulls a lever which closes and thus locks the doors. Then the nearest sheriff's office is notified by telegraph.

The electric indicator is a "burglar mat," operated by a battery under the floor of the car.

Light Up Your Satchel

AN electric lamp planned by C. H. Holton of Baltimore, Maryland, for ladies' arm bags can also be used in valises and suitcases, which travelers often have to use in dark waiting-rooms, berths, and state-rooms.

The apparatus consists of a small dry battery, with wire leading to an electric bulb and a switch mounted on the end of the steel frame. A thumb switch should be provided near the bulb, so that the light may be turned off.

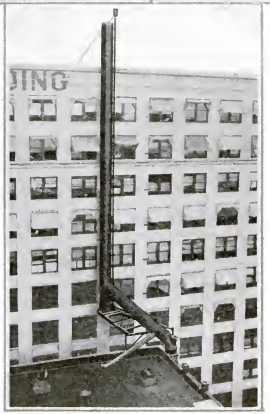
British official photograph

Converting Garbage into Good Pork

CALCULATE the worth of the food unavoidably thrown away in an army cantonment of fifty thousand men; add to this the expense of disposing of this waste; augment the total still more with the cost of feeding two thousand hungry hogs, and you will have an idea of the saving made by converting garbage into pork.

The photograph above, by J. L. Snypp of Henry Knight & Son, Louisville, Ky., shows the essential machinery of garbage disposal at a number of cantonments. The practice is, in fact, rapidly becoming general.

The graceful acknowledgment of the source of their food is too apparent in the photograph to need comment.



Special Apparatus for Saving the War-Horse

IN France, where the true value of a horse is appreciated, great effort is made to save its life. Many horses disabled by gun-shot and shell wounds, can be saved if they are transported to base hospitals. With this in view, a new horse ambulance, accommodating two patients has been built. It is so made that the body of the car can be revolved, thus enabling the injured horses to walk down the runway, when they alight instead of backing down. Above we see one of these ambulances just as the body is being revolved.

For Painting Traffic Lines

NOTHING could be simpler than the device for painting traffic lines upon asphalt pavements which Samuel R. Wilson has recently patented. A four-wheel cart carries a tank containing paint. A tube with a valve for regulating the flow of paint extends to within a few inches of the pavement. A few inches in the rear of the paint nozzle, and in the same line of direction, is a slidable bar to the lower end of which a paint-brush is attached, so that its bristles touch the pavement, when the device is wheeled along in the direction in which the traffic line is to be painted.

Morse Signals by Lantern

SIGNALING at night by means of the Morse Code isn't as easy as it may seem to be. But with the lantern shown above the operator can make and break the circuit with certainty, and turn the light on and off as he desires.

The Morse key which is used to produce the flashes has heavy platinum points, the base inclosing a condenser connected across the points of the key to prevent arcing and to shorten the lag between make and break.

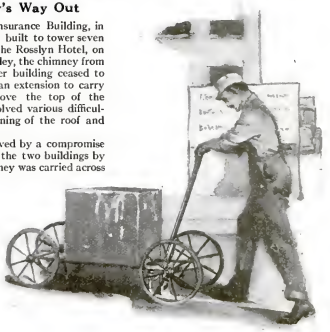
Any lighting circuit may be used, a plug and flexible cord making attachment easy.

This Chimney's Way Out

WHEN the Title Insurance Building, in Los Angeles, was built to tower seven floors above the roof of the Rosslyn Hotel, on the opposite side of an alley, the chimney from the kitchen of the latter building ceased to draw. The erection of an extension to carry the hotel chimney above the top of the insurance structure involved various difficulties, including strengthening of the roof and other alterations.

The difficulty was solved by a compromise between the owners of the two buildings by which the Rosslyn chimney was carried across the alley on a steel bridge and then up the side and over the roof of the Title Insurance Building.

The flue was built at about one third the cost of strengthening the Rosslyn roof; and, as the stack is at the back of the building, it does not detract from the appearance.



Flights—of the Imagination

Airships that soar only in the day-dreams of their inventors

IT has taken Joseph Ostand of Cincinnati, a Rumanian machinist, eight years to round up the conception of an airship shown below. It took so long because he wanted a perfect universal locomotion machine, practical equally for travel in the air, on water, and on land. And now he has got it and is getting out a working model. But it will not be of the kind that works, for neither he nor anybody else can make a small aluminum balloon that will support its own weight.

To Be Painted Sky-Blue and Carry Tourists

The size of the largest balloon he contemplates for his machine is only about eight by ten feet, with a fifteen-foot aluminum umbrella attached to it, and it would have to be held up by rods. He claims to be in possession of a secret gas; but no gas lifts more than the difference between the weight of the air it displaces and the weight of the gas plus its container. The container always weighs too much, unless the gas quantities are enormous. Ostand does not admit this or any other inconvenient fact.

His dream on paper only shows what ludicrous conglomerations can be formed when current ideas, such as lightness of aluminum, buoyancy of hydrogen gas, power of gas-engines, efficiency of air propellers, machine-guns, bombs, automobiles, and sea-planes, are turned loose helter-skelter.

An Austrian thus expresses the maximum of confidence in the helicopter and the physical prowess of aviators

The Ostand machine is to be colored sky-blue to conceal it from the enemy. It is to go fifty miles an hour, which seems modest. And it is to cross the Atlantic ocean, easily, with a load of tourists.

Two Novel Ideas That Come from One State

A maximum of confidence in the helicopter as well as in the physical prowess of aviators is expressed by an enemy alien, for Alex Melniczak, a subject of the Emperor of Austria but living at Camden, N. J., is responsible for the man-power helicopter. Anybody who can chin a bar ought to be able to work it with his hands alone, but the inventor provides foot-power also and, lo, by using free sprockets on the lay shaft, one can use either the hands or the feet.

When the aviator with this machine gets up as high as he wants to be, he can moderate his efforts and stay suspended. A balloon that can be added is only for mollycoddles.

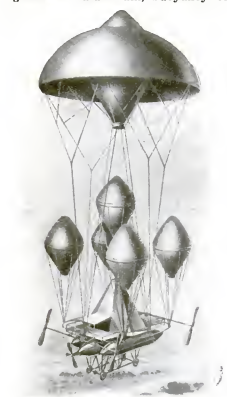
Perhaps Melniczak tried engine power first, and was discouraged by the weight of the machinery required. The deficit in his lift is, in fact, probably smaller than it would be with an engine, and on this basis he may be said to rank in the lead among helicopter experts.

The next friend of aeronautic progress leans to a calm, scientific contemplation of possibilities. Among learned and unlearned alike there are some who believe that the lifting of a flying-machine should be done by oppositely revolving spiral planes or air-screws mounted with their shafts in a vertical position, and not by the indirect method of the airplane, which lifts only when the propeller screw pulls or pushes it forward.

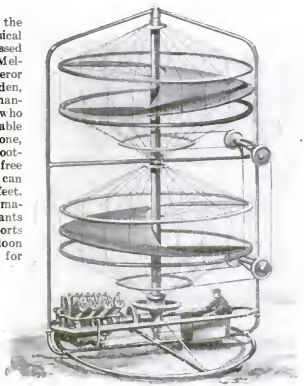
S. T. Matthews, who writes from Corney's Point, N. J., believes that the construction he shows would be a long step in the development of heavier-than-air machines, in comparison with mere propeller screws turned on end. His is a solid spiral surface hugging its shaft. The central portion of it is inactive for lack of speed, and hinders air from getting access to the more rapidly revolving portions near the rim.

The many wires specified by this enthusiast mean a greatly increased total resistance. But the plan is otherwise identical with that learnedly designated as helicopter design, whose advocates are always hazy on the question of propulsion.

As aviators want to get somewhere, and not simply to be hauled up in the air, and as no helicopter machine has been shown yet, even on paper, which could rise a mile as fast as an



Joseph Ostand pins his faith on aluminum balloons and a "secret gas" in his search for a universal machine



S. T. Matthews' expression of his belief that airships should be lifted by oppositely revolving spiral planes, or air-screws

A helicopter with an ingenious umbrella feature. It will do almost anything except fly

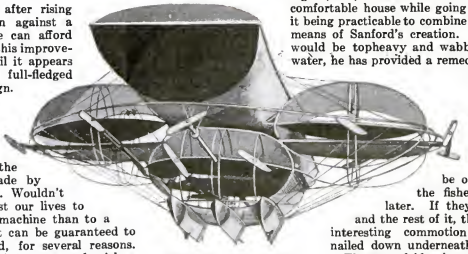
airplane, or which after rising could hold its own against a moderate wind, one can afford to be indifferent to this improvement—at least, until it appears as a feature in a full-fledged flying-machine design.

Here Is a Helicopter Machine that Is Different

Quite different is the elaborate effort made by John Oman of Texas. Wouldn't we all rather intrust our lives to Oman's helicopter machine than to a simple airplane? It can be guaranteed to stay on the ground, for several reasons. If the designer had been armed with a hand-book giving the weights of materials and the dimensions required in gears, shafts, and other machine parts for transmitting engine power in all sorts of directions through flexible joints, he could have figured out the impossibility of lifting its weight, in whatever size the machine was built. His mechanics are perfectly good and indeed exuberant, but his engineering is optimistic.

In the helicopter screws he bids farewell joyously to demonstrated facts. The eight-bladed screws will not scoop the air from one side of the blades to the other at any speed high enough to give lift or propulsion in appreciable degree, least of all from a standstill, where the best air-screws are at a disadvantage.

The umbrella feature is ingeniously worked out, with intricate mechanism for operating these protective accessories, rain or shine; but what chance have four five-foot umbrellas against three thousand pounds of metal seeking the earth from somewhere in the atmosphere?



Brinton's "blimp" looks promising on paper; but the experts bring weighty objections which will prevent it from rising so that we may see it in the air

Brinton's Blimp—He Calls It a Hydroplane

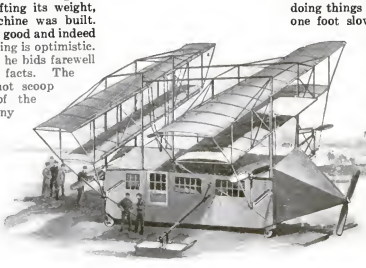
Much more rational is Brinton's blimp. It is in the class of airships which look promising in a small-size model, with dummy engines and propellers that do not revolve under power, with little strips of thin sheet aluminum bent into shapes that are convenient for stiffening the structure. But his blimp, if it is ever built life-size, will not fly until revised. Propellers are not manageable when mounted at the edges of flimsy structures or turned at angles with their shafts. Airplane wings are more exacting than horizontal sails of canvas, and cannot be moved broadside-on with success. By virtue of the three suspended boats, Brinton calls his conception a hydroplane.

A Comfortable House for Aviating or Fishing

Now for a really conservative thought with poise and moderation. The leading idea in the hydroairplane conceived by C. L. Sanford of Washington, Pa., is that it would be nice to stay in a comfortable house while going aviating or fishing, it being practicable to combine these two sports by means of Sanford's creation. While naturally it would be topheavy and wabbly when resting on water, he has provided a remedy. By keeping the helicopters going the top of the structure may be kept topmost.

Just what the effect of the four air-streams from the helicopters will be on the water and on the fishes is to be learned later. If they can lift his house and the rest of it, they should make an interesting commotion in anything not nailed down underneath them.

The second idea is to clear the way for a rapid rise of the house going aloft by turning the canvas of the airplanes on edge during the rising operation, for which purpose the canvas is stiffened and framed in small sections. One less confident of new ways of doing things might prefer to raise the house one foot slowly, and then shoot ahead as fast as the structure will go with everything working. The casters under this machine are of a strangely antiquated pattern. Could not the bold designer do better in this little detail?



C. L. Sanford dreams of a nice, comfortable house in which to fly or go fishing. He relies on the helicopter to keep his machine from toppling over

What True Americans Eat

Pictures courtesy of the American Museum of Natural History

Indians preparing corn flour. First a woman arrives with a load of acorns on her back, these are dried and shelled, then the dried nuts are ground into flour by pounding them in a mortar with a stone pestle. The flour is sifted by shaking it in a flat basket. The bitter flavor is removed by leeching in sand. It is boiled by mixing with water and dropping hot stones into it

This multicolored bread is made of corn meal. A thin paste is spread rapidly by hand over the highly polished surface of a large baking slab under which a fire is kept burning. In a few moments the liquid film is baked through and is then stripped off. It can be folded into any shape while warm. It is flat tasting, but a highly concentrated food, and it can be packed into a small space

The sacred corn of the Iroquois, said to be the original maize. Each kernel is inclosed in a separate husk

Four kinds of highly nutritious food: cactus nuts in the upper left-hand corner and piñon nuts in the lower left-hand corner, while on the right are shown yucca plants above and a dish of acorn flour below

A New York State Indian woman, a sachem's wife, grinding corn. She is using a large wooden mortar and is crushing the corn with a wooden pestle both ends of which can be used. It is narrowed in the center so it can be handled readily. On the floor at her feet are vessels of her own manufacture. In one are the whole ears of corn, in another the kernels still to be ground

A Real Goat-Getting Industry Born of War

Herds on the Santa Barbara Islands raided for meat and leather

This wild Billy is one of 100,000 goats, descendants of animals introduced into the Santa Barbara Islands by the Spaniards three hundred years ago, which now offer a new source of mutton and leather

A goat bottle baby playing that his nurse's shoulders are a mountain-peak. His elders furnish leather of the finer grades so much in demand now for clothing for aviators. Tanneries for making leather from goat hides, packing-houses to care for the meat, and refrigerator ships to take it to a hungry world, are all in the dreams of the island goat kings

The wild goat herds also promise to increase the milk supply. The kids in the picture were captured when only a few days old and brought up on the bottle at one of the island ranches. The goats are extremely hardy, easily tamed when caught young, and become productive milkers

The raw sun-dried hides bring thirty-four cents a pound. But there are many pounds running wild, and the ranchers are planning "goat drives" to make way for domestic sheep

Wild goat meat is as fine as any mutton that ever came out of a city meat-packing plant. These dressed animals are in the cooler of one of the island sheep-ranch headquarters

Skinning wild goats after a successful stalk in the hills. The sporting features of this industry will soon be replaced by more businesslike commercial methods

These two Billies were each about two years old when the hunter got them. At that age they make the best mutton and their hides are especially suited for high-grade shoes

Lighting up the foot-warmer before a ride. The fuel, in brick form, is conveniently stowed away in a drawer

A Smokeless and Odorless Foot-Warmer

IN the large number of open cars that will be in use this winter, owing to the reduced production of automobiles, a new type of foot-warmer will be welcomed. The heat-generating medium is a specially compounded powder designed to burn in a closed container without flame, odor, or smoke.

The heater is composed of a plush-covered container holding a drawer which carries the powder in brick form. The drawer is simply pulled out, the fuel is ignited with a match, the drawer is pushed in, and no further attention need be given it. The container weighs but five pounds complete with fuel, and it can be moved from place to place conveniently. It will give off heat for from six to eight hours.

The warmer is also made in hand glove, pocket, and bed sizes.

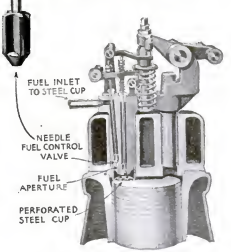
A New Diesel Engine for Trucks

WITHOUT any ignition device, without any carbureter, and without any intake manifold, the new type of semi-Diesel engine invented and patented by R. M. Hvid, a Danish-American engineer, promises to play an important part in the development of engines for motor-trucks and farm tractors. The Diesel type of engine is not new, but the problems of cooling the engine, of extra heavy cylinders required to stand the excessive pressures employed as compared to the ordinary gasoline engine, and the extra fittings necessary have made the pure Diesel type engine far too heavy for use as a vehicular power plant. These difficulties increase as the size of the engine decreases.

In short, the principal difference between the Diesel engine and the ordinary gasoline engine is that air only is compressed in the cylinders of the former type, instead of a mixture of air and fuel as in the latter. An essential feature of the pure Diesel type is that it requires, besides its own cylinders and pistons, an auxiliary air compressor capable of producing a pressure of up to seven hundred pounds per square inch to inject the fuel into the cylinders, which are so designed that the pressure at the beginning of the power stroke is about six hundred pounds.

The drawbacks of heavy weight, complicated piping, and the outside compressor used in ship-type Diesel engines have been overcome in the new Hvid engine. It is of the straight four-cycle type, preferably with an overhead valve mechanism.

On the suction stroke, only pure air is drawn into the cylinder through a regular inlet valve. The suction stroke is followed by the compression stroke, which compresses the pure air up to a pressure of 390 pounds per square inch when kerosene is used as a fuel and to 450 pounds when crude oil is used.



Hvid Type of Diesel Engine

A steel fuel cup is provided in the combustion chamber just above the top of the piston when at the highest point in its stroke. The fuel is fed into this cup through a mechanically operated needle valve. It is vaporized by the steel cup as the latter becomes red-hot. The air is forced inside of the cup through small holes near the bottom, and ignites with some of the fuel, causing a sudden rise in the pressure inside the cup. Some of the air in the cup forces its way out into the cylinder, carrying with it the fuel in a hot, atomized form, so that it immediately ignites with the incandescent air in the cylinder and burns, forcing the piston down on its power stroke. The fourth and last stroke, that of exhausting the burnt gases, is exactly the same as in any ordinary gasoline engine

A Self Opening and Closing Garage Door

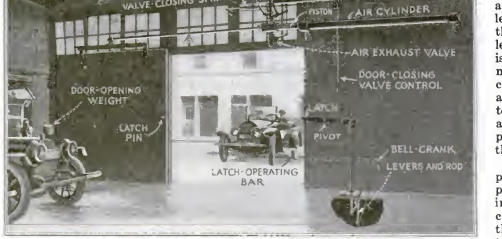
AUTOMOBILISTS will appreciate the convenience of the self-opened-and-closed garage door invented by T.W.Meiklejohn, of Fond du Lac, Wisconsin.

The principle of operation is simple, consisting of a mechanism for opening the door and another for closing it.

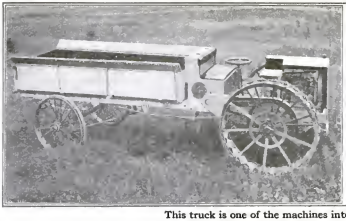
That required for the automatic door opening is perhaps the most novel, and consists of a bent U-shaped bar placed in the runway across the sidewalk leading to the door and releasing a pivoted door-latch by means of two rods and a bell-crank lever positioned in a covered trench under the sidewalk from the curb to the inside of the front wall of the garage.

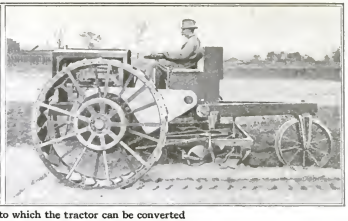
When the wheels of a car pass over the U-bar, the latter is forced against the runway, releasing the door-latch by means of the rods and bell-crank lever. As soon as the latch is released, the door is opened by means of a weight carried on a rope attached to the top of the door and run over a pulley placed on the garage wall.

By means of a pull-cord, compressed air is let into one end of a cylinder hung on the wall above the door, and closes the door.



The car crossing the curb causes the door to open, and an equally clever device inside of the garage closes it after the automobile





This truck is one of the machines into which the tractor can be converted

One Man Can Operate a Train of Three Automobiles

A NEW and novel method whereby one man can operate a train of three or even more automobiles has just been devised by W. M. Hinds of Los Angeles, California. This new system was brought about by the shortage of freight-cars for automobile delivery purpose, much of the rolling stock of the country now being used in war work.

This new delivery method is being employed in the delivery of cars to customers within a radius of three hundred miles.

Possibly the best thing about this new invention is that by its use the car in front is not compelled to pull two machines in the rear, the man in the front car operating, by a novel arrangement, the working parts of the two rear cars.

The cars are linked together by means of an especially devised "trailer hitch," by which the two rear cars are made to "track" absolutely with the first machine, so that no difficulty is experienced in turning corners. Another vital point is that the ignition systems of the two rear cars are connected by means of insulated wires to the switch clamp on the steering-post of the first car.

The two rear cars are then put in high gear, and the throttles are set to about twenty miles an hour, or as fast as it is desired to run. The driver starts towing them with the power of the first car, and when he has reached proper speed he throws in the ignition that controls the two rear machines, whereupon their motors start, this being caused by their being in gear and the rear wheels turning over the motor.

The operators of these trains have found that by having the motors of all of the cars running it is possible for the train to make a given grade on "high" that would be impossible to make even in "low" were the first machine compelled to propel itself and the two machines after it. When a train starts a descent, the brakes of the forward car only are used.

After the delivery of a train of automobiles or trucks, the coupling and operating devices are sent back to the home office by express, ready for another trip.

He runs three cars from his seat in the first one

A Combination Tractor and Road Truck

WITH the coming of the farm tractor on American farms (approximately one hundred thousand tractors will be made here this year), one of the farmer's greatest problems is his ability to buy an expensive farm tractor, and in addition invest two or three thousand dollars for a motor-truck in which to carry his products to market.

The ordinary farm tractor, with its one or two plowing speeds and its wide cleated wheels, is obviously unfitted for road work.

To overcome this difficulty, a St. Louis concern has just brought out a farm tractor which is convertible into a motor-plow, a tractor, a motor-truck, and a farm power machine for belt-drive work. The machine has three wheels when employed as a plow and as a tractor, and four wheels as a motor-truck. This is made possible by driving through the two large steel front wheels, the third wheel being a small removable one.

The machine is provided with a motor-truck type of engine, and has a two-speed gear-set which gives a plowing speed of from two to three and one quarter miles an hour, and a road speed of eight miles an hour. Four-inch wheel bands are fitted around the big driving front wheels when the machine is used as a road tractor to haul loaded trailers out of the farm lanes to the main road.

Since all of the propelling mechanism works through the front instead of the rear wheels, it is a simple matter to remove the auxiliary third balance wheel and attach a rear frame with two smaller wheels and a conventional box-type body large enough to carry three tons of farmer's products.

Combating Man's Deadliest Peril

How the Unending Struggle Between Gas and Mask is Carried On

ONE of the many remarkable innovations in the methods of warfare which the great World War has developed is the use of poisonous gases as agents of warfare. When, in the spring of 1915, the Germans made the first gas attack, using chlorine, which a favorable wind carried in the form of a heavy greenish cloud toward the French lines, their adversaries were entirely unprepared to meet that attack. But the necessity of protecting soldiers from this new and highly effective weapon was promptly recognized, and soon every soldier of the Allied armies on the west front was equipped with a gas-mask.

The first gas-masks consisted of respirators, saturated with some alkaline solution intended to absorb the poisonous gas. Simple as these first gas-masks were, it was an enormous task to provide a sufficient number for the troops at the front. Several millions of them were made by the women of England in response to an appeal by the late Lord Kitchener. Later on this gas-mask was improved; it became a helmet of flannel with a mica window in it.

New Gases—New Masks

When the Germans, dissatisfied with the uncertainty of chlorine, began to use phosgene, another poisonous gas, the masks used against chlorine proved useless. The helmets had to be more complicated, and it was necessary to use several chemicals to give adequate protection to the men. The best absorbents were found to be sodium phenate and urotropine. A valve was provided for exhaling air.

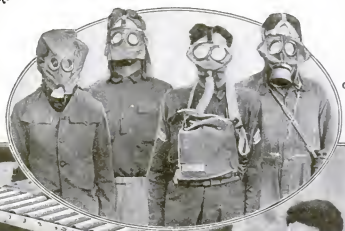
The Germans continued their experiments with different poisonous gases, and tried at least twenty different kinds in clouds or in shells. To protect the soldiers against these gases was a difficult problem, requiring a variety of masks and chemicals. What complicated matters was the fact that the Germans, to break through the defense of the gas-masks, changed from one gas to another in rapid succession, or used two or three different gases at a time.

Introduction of Gas Shells

In 1917 the Germans practically abandoned the use of gas clouds, and introduced bombs and shells containing substances which, by the explosion of the missile, were vaporized or scattered in the form of minute drops. The tear-bombs, the sneezing-gas shells, and the shells containing "mustard gas" belong to that class. More than ever, gas-masks became a necessity, since the shells containing these poisonous substances could be fired to a distance of twelve or more miles.

This gas-mask, built for American fighting men, is the latest word in scientific protection against the poison gas menace

The French gas-masks are comparatively simple—merely a face covering with a pocket containing chemicals through which the breath is drawn and expelled. The breathing is done through the nose. The English and American masks are comparatively complicated box respirators. They comprise a head-covering, a nose-clip, an aluminum mouth-piece, and a chemical box with check-valves and a flexible tube extending from the chemical box into the mouth. As the nose is closed by a clip, the breathing must be done through the mouth.



Crudely constructed masks of the early days of gas warfare (on the left) contrasted with later and more efficient designs

The parts of the masks for the United States army are made separately, and after the most careful inspection are turned over to a corps of operators, who assemble them

Thousands of women are employed in the Gas Defense Service under the direction of the Surgeon-General. Here they are testing aluminum respirators and mouth-pieces

Saving 100,000 Lives This Year

A fully equipped dispensary on wheels. The tent on the right is attached to the automobile, and folds up. It toured Cleveland, examining babies in the "Children's Year" work

The Social Service of Bellevue Hospital, in New York, weighing and measuring babies. All the records are sent to Washington, so standards of the nation's babies can be made

THE loss of life caused by the war has awakened the nation to the need of conserving life. The horrors of the yearly war fatality lists are bad enough, but what about the 300,000 children under five years of age who die each year in the United States? Isn't that a sad record for non-combatants—especially when 100,000 of these deaths could be prevented?

The United States Government is making a determined campaign to save these lives. This is "Children's Year." Each State has been assigned its quota of lives, and New York city is responsible for the saving of 4,700 children under five years of age. The Government has asked that all the children in the country be weighed and measured, and that copies of their score cards be sent to Washington, in order to establish national standards.

A very interesting method of carrying on the work of examining the children has been devised and used by Dr. Richard A. Bolt, head of the Bureau of Child Hygiene of Cleveland, Ohio. He established a traveling dispensary—an automobile truck completely equipped as a dispensary. Each day the truck is sent out in charge of a doctor and a nurse. Its location is announced from day to day, and mothers are invited to bring their children for examination. If a child is suffering from any physical disability it is treated by the physician. The mothers are instructed in hygiene and proper feeding.

Dr. Bolt has been made Child Director of the American Red Cross in Italy, and, in order to help the Italian babies to become "better babies," his trucks are now traveling over the roads the Romans built. They will be sent regularly to fourteen districts.

Dr. Bolt believes in prevention; and prevention of disease will be the gospel preached from his trucks. Tuberculosis is often due to the breaking down of resistance in childhood, and it is this that Dr. Bolt hopes to prevent from occurring in the coming generation.

Germs May Be Just as Deadly as German Gas

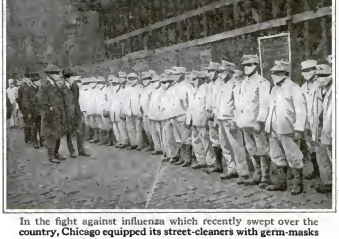
IF it were not for the familiar uniform, you might suppose that this was a regiment of highwaymen lined up for inspection before getting to work. But, as you have probably guessed, the men in the picture are street-cleaners trying out masks to protect them against the influenza germ.

When the so-called Spanish influenza epidemic swept westward, Chicago took prompt measures to protect its citizens.

No class of a city's workers are more exposed to contagion at such times than are the street-cleaners, who might with justice be called the first line of defence in the health battle.

Taking a tip from the successful efforts to combat poison gas on the battlefields by the use of masks, the Chicago authorities equipped its street-cleaning force with masks very like those first tried out against gas.

These masks were simple and inexpensive, consisting merely of pieces of fabric saturated in disinfectant, and held in position over the nose and mouth by a handkerchief.



In the fight against influenza which recently swept over the country, Chicago equipped its street-cleaners with germ-masks

Housekeeping Made Easy

A cone-shaped colander with a hollow central column, which serves for a sleeve in the upper end of the handle. An inner grating shreds the food, forcing it through the perforations in the outer cone

With heating elements placed in the seams between the bark and logs, this electric heater looks like the real thing

A combined rack and serving tray for the sick-room. The rack is for cloths, towels, and the like, while the tray extends over the patient's bed and may be used for serving meals or for holding books or other articles

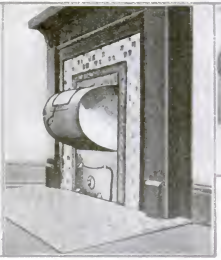
A canvas-covered substitute for the old wash-board

The latest thing in clothes-closet decoration is to line the walls with cretonne to match the hangings in a room

With this device the gas-jet heats as well as lights the room

This metal-polisher looks like a pencil-eraser: it removes rust by merely rubbing the metal surface

This little closet is built at a convenient height in the wall to house the telephone

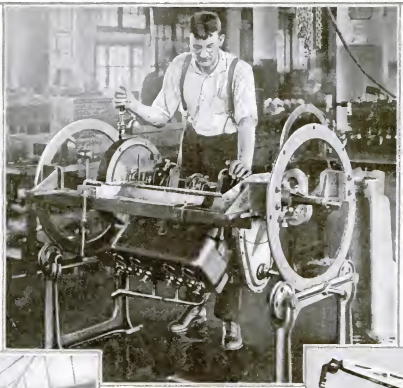


A grate stove that is made to fit in any fireplace opening: it uses kerosene

The candle in this style holder is held flush with the tube by spring pressure, preventing drip

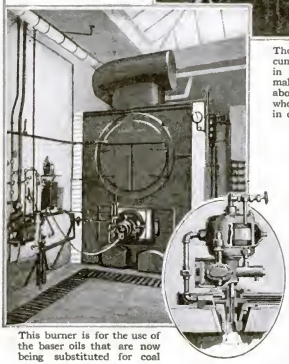
Do It with Tools and Machines

A current tap in combination with the ordinary electric switch. It is placed in the regular switch receptacle

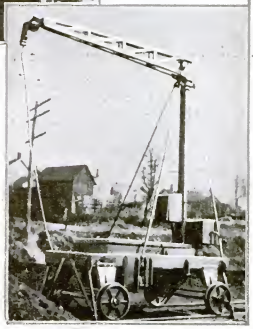


The automobile engine is a cumbersome thing to manage in assembling, and also when making repairs. The stand shown above holds the engine so that the whole thing may be turned over in order to reach the under part

The painter using a putty-knife to fill up depressions in old surfaces will have a nail extractor with this knife

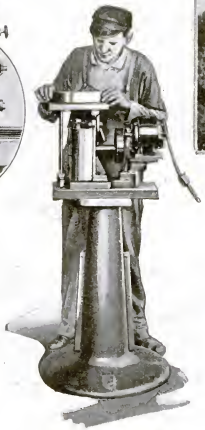


This burner is for the use of the baser oils that are now being substituted for coal



This crane was built originally for a tie loader and unloader; it is now built in quantities for many purposes

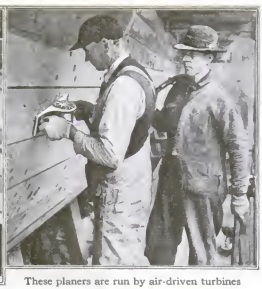
The new pistol grip-saw set is easily handled in making a uniform set to the saw teeth



In making dies and parts for model machines this filing machine is essential

Tools that draw the strapping tightly around boxes, thus very effectually sealing them

The dissected boat packed on the footboard



These planers are run by air-driven turbines

Going Motoring in the South? Take Your Boat Along

FOR the convenience of automobile tourists who are also fond of boating, George M. Clark, of Battle Creek, Michigan, has invented a boat in sections which can be taken apart, nested, packed in a crate, and carried on the footboard of an automobile. The boat is preferably constructed of sheet metal.

The inventor assumes that it is possible to bring the sections together by clips and bolts so that it will be water-tight, but the owner of one of these sectional boats will probably find it necessary to employ some kind of packing.

Planing Ship Timbers with Little Machines

PERSISTENT labor troubles in these speed-the-war days put labor-saving machines at a premium. Here, for instance, are some mechanically driven planers that can do the work of many men. They have been adopted by several shipyards. They are rotary machines operated by air-driven turbines at a speed of from 8,000 to 15,000 revolutions a minute.

There are two kinds. One is light in weight and is especially adapted for use on shipsides, as shown in the picture to the right. The other is heavier, and is used on massive timber, such as we see in the other picture.

In several contests with hand planers these little machines were voted the winners.

One light-weight machine planed 385 square feet of wood in less time than it took fifteen men armed with hand tools to plane an equal surface. And the heavier planer took three quarters of an inch off timber, sixty feet long by twelve feet wide, in fifteen minutes, whereas nine men with hand planes needed twenty-two minutes for the same job.

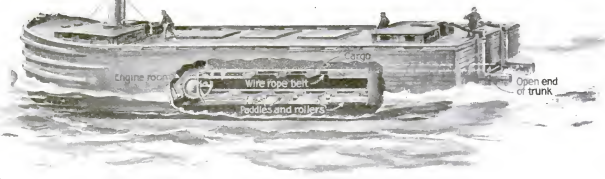
Labor-saving machines like these are invented daily: therefore, strikers, beware!

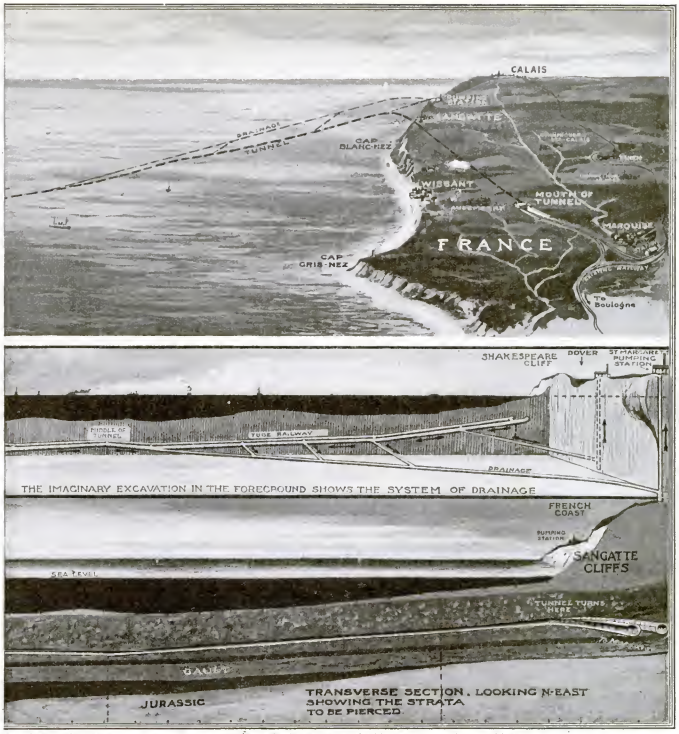
The Caterpillar Is Now Being Applied to Ships

WHO ever heard of a water caterpillar? Yet not only have they been invented, but their invention antedates the invention of the land caterpillars by many years. The first water caterpillar on record was invented by Desblancs in 1782, and was propelled by a steam-engine. In the United States the first marine caterpillar was patented in 1839, by William Leavenworth, of New York. Since then more than two hundred patents have been granted to various inventors of marine caterpillars by the United States Patent Office.

Well, what is a marine caterpillar? It is a ship propelled by an endless chain of paddles passing around drums located forward and aft. The drums are driven by an engine in such a manner that the lower part of the chain, which is in contact with the water, is drawn in a direction opposite to that in which the ship is traveling.

This water caterpillar was invented and used for canal traffic half a century before the invention of land caterpillars





American engineers have estimated that the tunnel—the latest plans of which are shown here—will take less than five years to build. The cost is placed somewhere between $80,000,000 and $90,000,000

ground to ascertain the precise location of any fissures or faults. It will be used as a drainage tube, and will rise up to the center of the Channel, so that water will flow down in each direction and be pumped up at Dover and Sangatte.

It will take four years to construct this tube, but it will reduce the time required for the entire work. By its means chambers will be excavated in the middle of the Channel, and from these chambers it will be possible to drive the tunnels both from the shore ends and backwards from the center, and to carry off the excavated material through the tube.

The French have consented that the power-house shall be stationed at Dover under the complete control of the English. The mere pulling of a switch handle would cut off the electrical power in time of war.

There is to be a dip in the tunnel which is to form a water-lock. An officer at Dover has only to open a sluice-gate in order to flood the tunnel from rails to roof for a mile. It is an ingenious method of blocking communication with the Continent, and it ought to commend itself to investors who might worry about the cost of restoring the tunnel. The water could easily be pumped out.

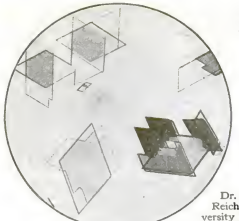
Thirty-five years ago, when the tunnel was actually in course of construction, it was thought that the work could be completed in six and a half years. American Engineers now say that this time could be reduced to a little more than four years. As for the cost, that would remain at the original figure of $80,000,000—possibly $90,000,000.

From the interest that the British government has been forced to take in the Channel tunnel as a result of the war, it may be inferred that its construction will be the first great engineering feat to be undertaken after the war.

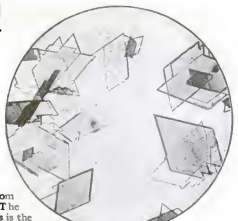
Blood Will Tell

Is man descended from the monkey? Are you well or ill? Your blood crystals will tell

By Anna Heberton Ewing



Dr. Edward Tyson Reichert, of the University of Pennsylvania, found that the blood crystals of a horse look like this



Blood crystals from another horse. The formation of crystals is the same, but the measurements and the groupings are different

THEY found the body of the dead man in his room. He was a Frenchman who had lived alone. It was clear that he had given up his life only after a terrible struggle. There was blood on the floor and on the walls—blood everywhere except upon the body itself. Nor were there any wounds. The man had been strangled to death. And the blood? The dead man must have wounded his murderer.

And so the detectives of the French town in which the crime had been committed looked about for a wounded man. They did not find him. There were finger-prints enough. They revealed nothing; for they did not correspond with any finger-print records at police headquarters.

At last it occurred to an official that perhaps the blood with which the room was so liberally bespattered should be analyzed. That was done. It was not the blood of a human being at all, but the blood of a bull!

Two Strange Murder Cases

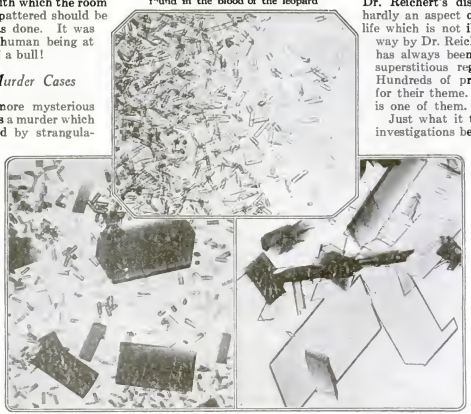
The crime was more mysterious than ever. Here was a murder which had been committed by strangulation; the finger-marks on the throat were those of a strong man; yet the blood in the room was that of a bull. True, it would be easy to obtain blood from a slaughter-house; but why?

Someone remembered that one of the few persons who disliked the murdered man was one who worked in a slaughter-house not very far away. He was arrested. His finger-prints agreed with those upon the wall of the room where the crime had been committed. The man confessed; he was the murderer. Yes, he had spattered the blood of a bull around the room. Why? So that he might insist, should he be arrested, that he had fought and killed in self-defence. To bear out the story, he had even cut himself.

Another case:

The only evidence of a murder upon which the police could work was a pair of blood-stained trousers. The suspected murderer grieved, apparently sincerely, over the death. Indeed, he had evaded suspicion to a certain extent by taking an active interest in the investigation. When the trousers (his trousers) were discovered he assumed an air of outraged indignation. He had killed a goose shortly after the murder, and had splashed himself with its blood. The story was plausible; the man had kept poultry. The District Attorney ordered the blood examined. It was the blood of a human being. The man confessed.

These small, bar-like crystals are found in the blood of the leopard



A tiger's blood crystals. The darker formations indicate thickness, not color

Because of the hybrid character of the mule, its blood presents an interesting study

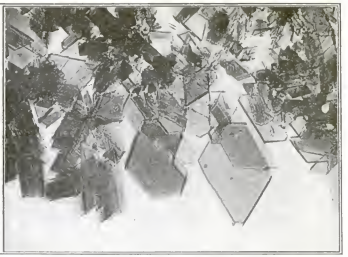
Science to the Aid of Law

Thus science comes to the aid of the law. To Dr. Edward Tyson Reichert, the internationally famous physiologist and biologist of the University of Pennsylvania, belongs the credit of having built up the new science of blood crystallography, which has made it possible to bring criminals to book so surely. But that is, after all, only one phase of the wide application of Dr. Reichert's discoveries. There is hardly an aspect of plant and animal life which is not illuminated in some way by Dr. Reichert's work. Blood has always been held in a kind of superstitious regard by humanity. Hundreds of proverbs have blood for their theme. "Blood will tell" is one of them.

Just what it tells, Dr. Reichert's investigations begin to show us.

It all came about in a very curious way. One day a scientist in a laboratory was interrupted in the examination of a drop of blood. Impatiently complying with the demand upon his attention, he left his task for a few minutes. Returning, he resumed his work at the microscope. To his astonishment, he beheld upon the slide a totally transformed specimen. Hardly realizing the great

One of the three forms of blood crystals in a human being; another form is like prismatic rods; another diamond-shaped



One of three forms of crystals in the blood of anthropoid apes. The diamond shape is similar to one of the human blood crystal formations

significance of the change that had taken place, he nevertheless recalled the way in which he had prepared the specimen. He experimented again. Once more the peculiarly formed crystals appeared. Scientists became interested and repeated the experiment, but made nothing of it. To Dr. Reichert and some other specialists the red crystals with their sharp edges and flat surfaces presented a scientific problem of irresistible interest. Did the crystals in blood really convey a message of which any practical use could ever be made?

Dr. Reichert decided to solve the problem. He secured blood of wild and domestic animals, the former with danger and difficulty. He made tedious and refined tests of human blood. An exhaustive study involving years of patient effort and highly specialized knowledge in biology, crystallography, and physiology began. At last he succeeded in disclosing scientific facts of inestimable value to every scientific man who studies living things.

Bloodstains used as court evidence in blood crystal tests should be fresh, or only slightly clotted, to yield positive results for testimony

Dr. Reichert's Discoveries

The blood is an extraordinarily complex fluid which consists of what is called the plasma, in which living cells, "corpuscles," are held in suspension. Most of us think of blood as red; yet not all blood is red. In the lower animals the blood corpuscles may be colorless or colored, and if colored they may be green, red, yellow, blue, violet, purple, madder, mahogany, brown, or lilac. Some blood has corpuscles of varied hues.

In all cases perhaps the principal function of the blood and in particular of the colored constituent of blood is the assimilation of oxygen from the air. We breathe in order that our blood may breathe; for we care about oxygen only in so far as our blood corpuscles care for it.

Now, one of the discoveries recorded by Dr. Reichert was that the red coloring matter of our blood, which is called "hemoglobin," is closely related to the green coloring matter of higher plants, called "chlorophyl." Our blood is red merely because it contains iron; the blood of an octopus is blue merely because it contains copper.

The red blood corpuscles of the higher animals are inconceivably numerous. It has been estimated that the total number of cells in the human body is 26,500,000,000,000, and that of this number 22,500,000,000,000 are red corpuscles. Think of this vast crowd of corpuscles—numbering in the case of man more than 10,000 times the population of the earth—hurrying through the channels of our system at such a rate that the majority of them complete one entire circuit in the space of less than a minute! The traffic of the New York subways is slight in comparison.

It is the crystals formed by blood which reveal so much to Dr. Reichert. Suppose he has a specimen of blood to be examined. Dr. Reichert adds oxalate of ammonium to prevent coagulation. Then he shakes the mixture with ether to free the hemoglobin from the corpuscles in which it is found. After that the ether is separated from the mixture, and some of the latter is placed on a microscope slide, protected with a glass cover, and sealed with Canada balsam.

Slowly the crystals become visible under the microscope. They can be identified by reference to the Reichert classification of blood crystals.

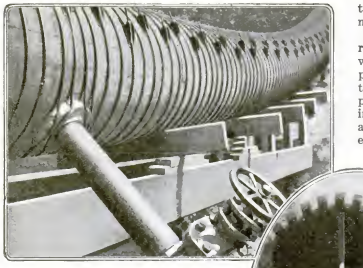
Soon after he began his investigations, Dr. Reichert found that the blood crystals of one species of animal can be distinguished from those of others and that blood crystals of the human being can be differentiated from those of the lower animals.

Blood of Apes and Human Beings

Striking is the likeness between the blood crystals of monkeys and human beings. Such close similarity does not exist between the crystals of the monkey or human being and those of any other living species. Blood crystals under the microscope shed a flood of light on Darwin's theory.

Dr. Reichert hopes to distinguish between various nationalities by blood tests, to fix race relationship more scientifically than is now possible, and even to trace hereditary traits. He has also directed his attention to the study of the cause and prevention of such phenomena as two-headed children, one-eyed calves, etc.

Piping Water through Miles of Redwood



This is a blow-off valve in an inverted redwood siphon in California. These blow-offs are inserted at the lowest point of the pipe in order to remove any sand which may have settled.

A wood-stave pipe which supplies water to a paper plant at the top of the Sierras. This pipe is nine feet in diameter

WOOD pipe once consisted of bored-out logs, joined end to end. Modern wood pipe is built up of separate staves. Iron hoops placed at short intervals on the outside enable such a pipe to withstand a wide range of pressures. In the mountainous regions of the West, where the pipe lines cross rough, unfrequented country, the transportation of heavy iron or concrete pipe would be difficult. The fact that the staves for wooden pipe can be loaded into wagons, like ordinary lumber, gives the wooden pipe an immense advantage.

Wood pipe will not contract and expand with changes in temperature as do pipes of concrete or iron. Serious and leaky cracks are therefore not developed as a result of alternate periods of hot and cold weather. Still another point in favor of wood pipe in some installations is that water transported through it freezes much less readily than in iron. Also electrolysis, that bugbear of many iron-pipe systems, affects wood pipe not at all, since electricity will not travel on an insulator.

Curiously enough, wood used in water piping does not rot readily. This is particularly true of the redwood, widely used in the West. Redwood fiber seems to possess peculiar properties in that it is but little affected by weathering, acids, insects, or fungus growths. Made up into pipe, such wood stays smooth and clean on the inside indefinitely. Iron pipes, however, speedily become scaled and corroded, the growths sometimes becoming formidable enough to reduce the flow of water to a mere trickle.

Where Future Rheumatics Will Take the Cure

ONE of the diversions of an airplane voyage to Europe, by way of the Azores, in the year 1925, will be a hot bath at the hitherto somewhat neglected watering-place of Las Furnas, on the island of St. Michael.

The valley of Las Furnas ("the caverns") is the huge crater of an extinct volcano, 600 hundred feet above sea-level, about 27 miles from the quaint city of Ponta Delgada, the chief town of the Azores. The ground around the springs is entirely covered with native sulphur, resembling hoarfrost. The largest spring, known as the Caldeira Grande, supplies hot sulphur water to bath-houses which have been erected by the Portuguese government. This water is said to be delightful to bathe in, and a remedy for rheumatism.

The ground around the great Caldeira shudders with a bubbling movement under one's feet. Though it is not hot to the touch, if you poke a stick down into it, it comes forth smoking. The Caldeira itself boils with a deafening roar and pours forth great volumes of dense evil-smelling smoke.

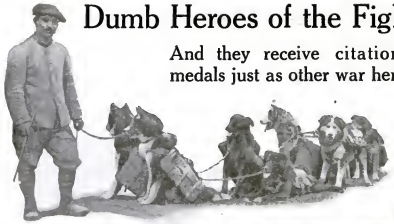
One of the curiosities of this valley is a crevasse from which issue vapors destructive to animal life. Birds fall dead if they attempt to fly over it.

With a giant hot-water spring like this always on tap, the business of running a Turkish bath ought to be profitable

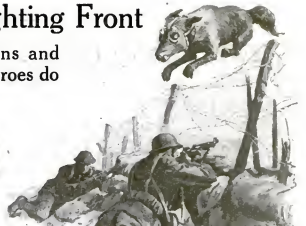
They call this the "Mouth of Hell"; but out of its unfathomed depths comes mud that heals skin afflictions

Dumb Heroes of the Fighting Front

And they receive citations and medals just as other war heroes do



Bringing up food and ammunition when the roads are blocked with snow



Through rifle fire and gas clouds the dispatch dog brings word from a menaced outpost

PICARD: on March 28 particularly distinguished himself as a messenger during an attack by accomplishing under heavy rifle fire and in the face of a violent barrage a journey of 3,000 meters, four times repeated.

BRUTUS: on 27 and 28 January discovered three enemy patrols and gave the alarm. He was killed at his post.

• DUNO: was blown high into the air by the blast from a shell and momentarily disabled, but after being revived continued on his mission without showing the slightest fear of the many shells bursting along his path.

These official citations, taken from the French records, tell of the brave deeds, not of men, but of dogs—real dogs of war, whose services as messengers, advanced sentinels, and Red Cross aides will some day be told in a book that will thrill dog-lovers and shame the enemies of man's best friend.

French Dogs the Best Trained

Germany was the first of the warring nations to recognize the value of the dog in military operations, and was said to have had 2,000 of them in the field a year ago. But the French were quick to catch the idea, and they, perhaps, have carried the training of the war dog to the highest point. President Carno, of the French Court of Appeals, who has written a manual on the war dogs, says that to make a good messenger of a dog requires more work and patience than is necessary in preparing him for any other service. He writes:

The dispatch dog works day and night. It is possible that he rests five or six consecutive days, and it is possible that he has to work two days and two nights without cessation, resting very little and eating only when he has time. He must carry the dispatches rapidly between corps commanders; he also carries the small postal bags, artillery letters, etc., when the telephone is cut by the barrage fire, or when it is impossible or dangerous to establish telephone lines. Not even the appetizing smell of food is able to turn him from his route. He is conscious of his duty, which he accomplishes with courage and rapidity.

On outpost duty. The dog will catch the slightest sound at a distance of 100 yards

The dogs of war, after some difficulty, have actually been taught to wear gas-masks

These sturdy animals can draw many times their own weight when attached to the little cars that run on narrow-gage railways

Gas-Masks for Dogs

When the Germans began to use gas freely, it looked for a time as if the usefulness of dogs at the front was at an end; but it was found that the dogs could be trained to wear specially constructed gas-masks, and, thus equipped, to go about their work guided by instinct, although bereft of the keenest of their senses.

The mask does not interfere with the dog's hearing, which is capable of catching the smallest sound at a distance of from 100 to 150 yards; and so, as soon as a way had been found to protect him from the poison gas, he took his place as the most valuable of advanced sentinels.

They Learn Quickly

After a few days in the front lines the dog sentry understands his work thoroughly—and he loves it. At the signal to go on duty he shows the same signs of pleasure that the field champion does when he sees his master prepare for a day with the birds.

Imagine the comfort to a soldier of a well trained dog at his side as he crouches on the edge of No Man's Land. He can see nothing himself, but a throaty growl warns him of approaching danger.

Less spectacular but no less useful are the draught dogs used to bring up food and ammunition when the snow in Alsace and in the Vosges makes transportation difficult. Most of these dogs come from Alaska and Labrador.

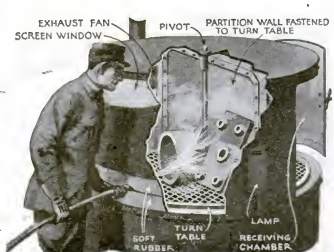
"Digging In" After a Rush—The New War

A FRENCH aviator took this picture of an assault as it is now conducted since "the war of movement," as the experts call it, was instituted. There is nothing haphazard about a charge such as this. The men are never for a moment left to their own devices: always a non-commissioned or a commissioned officer shouts instructions. The platoons proceed in waves. The first wave is in skirmishing formation, with four or five feet between the men. The second wave moves at ten to fifteen paces behind the first.

Making Things Easier for the Sand-Blaster

SAND-BLASTING has always been considered dangerous business. Because of this, helmets and masks for protecting the workers held the undivided attention of mask inventors until gas-masks came along. But there never has been invented any absolutely safe protector for the blaster, and flying dust is bound to get at him.

The best way to overcome this is to work from the room next door. Here is a recent invention, an individual sand-blast room, which works on this principle. A circular platform, partioned into halves, is mounted on a pivot and is inclosed in a small "room." The work to be blasted is placed in one of the halves.



This individual sand-blasting "room" provides a sure way of protecting the blaster

The operator stands outside of this room and inserts the hose through a small opening covered with a strip of soft rubber. The rubber is split horizontally, so that, while the hose moves freely, no sand escapes. A wire-screen window in the wall of the room enables him to look in at the work, which is illuminated by two special lamps. An exhaust fan inside keeps dust away from the window.

The platform is grate-like, and the sand, when its energy is spent, sifts through it into a tank underneath. This tank is connected with the hose, and the sand returns to its source. The operator then revolves the platform, letting the finished work out.

in the Open as an Airman Glimpsed It

Behind the second wave, at twenty to twenty-five paces, is a third wave, formed of parties from support platoons. There may even be a fourth and fifth wave, and, behind them at about six hundred feet, supporting companies with machine-guns and very light artillery.

There is no mad rush. The enemy pours in a steady hail of machine-gun, rifle, and artillery fire. Now and then the charging battalions must take to cover. There is no time to excavate a trench. The charging soldier is satisfied if he can provide a shallow trough for himself.

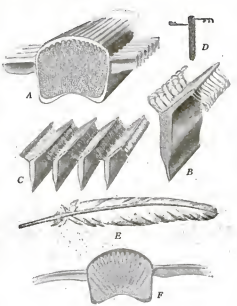
The Astonishing Structure of a Feather

FEATHERS are classed among the so-called "common" things, but their structure is astonishing in its perfect adaptation of means to an end.

A feather may be roughly divided into midrib and vane. The midrib is the long, tapering central shaft. A glance at its cross-section (*F*) shows the midrib's features of lightness and strength—the essential principles of bridge construction.

In flight the bottom surface of the midrib is subject to tension, so the material in this part is distributed with reference to this requirement. The top surface is doubly convex and also thickened. In addition, it has a number of longitudinal stiffening ribs extending down into the pith (*F*). An odd superficial effect of these ribs is to suggest fine longitudinal corrugations (*E*).

By drawing a feather between the fingers from tip to base, the vane will be separated into its component parts, called "barbs." These are themselves miniature features, with the bases of their thin but very deep midribs joined to the main midrib like a floor-joist headed to a girder (*A*).



Lateral bracing is secured by the interlacing of their barbules, the fringe-like processes extending along both sides of each barb. These barbules are specially designed for firmly gripping one another (*B*).

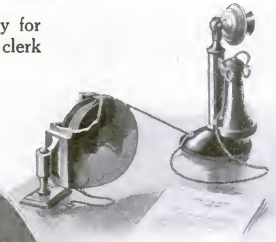
At *C* are shown several barbs in position. The downhanging hooks from the upper set of barbules engage the upturned hooks from the lower set of barbules on the next barb.

Feathers vary in structure in different birds, as may be seen by comparing *D*, which is from the wing of a parrot, with the other barb sections, which are from the wing of a hen.

Handy Office Devices

Nine aids to efficiency for the use of the office clerk

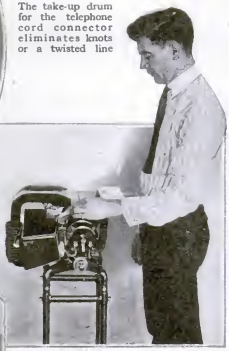
Similar to a card-index tray, it is used for sorting checks



The take-up drum for the telephone cord connector eliminates knots or a twisted line

When a card is taken from the tray, the retaining attachment holds the location open

A combination tray and binder for ledger sheets while making entries

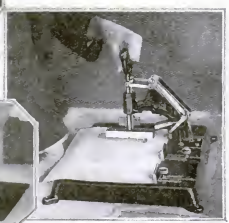


Endorsing checks on the same machine that adds their amounts

An arm-rest for convenience in writing on the last few lines of a page

A convenient little tool for cutting slugs and leads in a print-shop

A loose-leaf file-holder that has a removable fastener for taking out the contents bodily



A signature stamp writing-machine for use where many papers are to be signed

Teaching Student Officers to Read Maps

How a difficult science has been simplified with the help of the motion-picture camera

A MILITARY map is highly concentrated information. Every square inch of it is a record of valuable facts. It may show the character of a railroad; the number of its bridges, and their type; the number of its sidings and their location; the telegraph and telephone connections; every group of trees, every little creek and brook; every road; the population of a village; the location of churches in the village; whether the houses in the village are built of wood or masonry; swamps outside of the village; whether bridges over streams will sustain artillery and tractors; whether the water in the stream is drinkable.

Map-Reading Is Difficult

All this information is imparted by conventional signs which can be read only after training. An officer trained to read maps has only to look at a map in order to visualize the unevenness of a terrain. Every hindrance becomes perfectly obvious to him. Perhaps the most difficult features of a map to understand are the contour lines that symbolize unevenness of ground. Any unevenness of the ground amounting to more than ten feet is carefully recorded on a detailed military map. The map-maker conceives every hill and mountain as a series of layers, each ten feet thick. Where these layers appear at the surface, there is a visible line on the map, termed a contour line. The wider the contour lines, the easier the slope.

Suppose an artillery officer is ordered to plant his battery on a hill fifteen miles away. Which is the easier side to ascend? The contour lines will tell him.

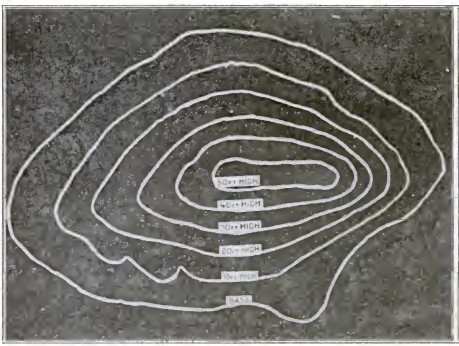
Looks like quite a hill, doesn't it? In reality this object lesson for army officers is about one foot high

What Contour Lines Mean

In training the 100,000 officers who are to lead our millions of men to victory, the General Staff found that lawyers, doctors, professional men, merchants—the class from which our officers are drawn—could not understand how the contour lines on a map indicate the height of hills. To help the Training Division of the War College, Mr. Max Fleischer, a former member of the POPULAR SCIENCE MONTHLY staff, devised for the General Staff the system that we illustrate.

An artificial hill was constructed—not a Mount Washington, but a little mound about one foot high—on which contour lines were painted. On a picture it looked for all the world like a formidable eminence. Over this mound a curved track was constructed on which a motion-picture camera traveled. The camera performed the same functions as an observer in an airplane. As it moved up the track it looked at the mound below. When the motion-picture film thus obtained is projected on the screen, the hill apparently tilts itself, so that the spectators look down upon it. The contour lines, thus seen from above, appear exactly as on a map.

When that film is projected before a class of student officers, every one of them realizes that the contour lines indicate heights and slopes—that it is only necessary to begin from the outer line and calculate toward the center to discover the height.



The contour lines as seen from above. The picture at the top of the page shows that the lines are closest together on the steep side of the "mountain"

The curved track enables the camera to view the "mountain" as an airplane observer would

Once Worthless Things that Have Suddenly Become of Value

Extracting the stones from peaches as a first step in gas-mask construction

The gang bombarding the horse-chestnut tree has enlisted in war work

Barrels like this, put on street corners in the peach season, collected countless bushels of pits

THE unusual conditions caused by the war, especially the lack of certain important raw materials, have led to the substitution of substances heretofore considered without value for the unobtainable raw material. The despised nettle is now used extensively in Germany as a substitute for the cotton which America and Egypt no longer supply. Substitutes for rubber and other unobtainable raw materials and foodstuffs are used in all the belligerent countries.

Notice what the men in one of the accompanying pictures are doing—rubbing the pulp of a carload of half decayed peaches through a screen to separate it from the peach-stones. For peach-stones have suddenly become valuable.

Another picture shows one of the methods employed for collecting peach-stones by a direct appeal to the people. And for what purpose are the peach-stones used? They are cleaned, dried, and then subjected to a high temperature in iron cylinders. The stones become carbonized, and the coal, in granulated form, is used as an absorbent in the manufacture of gas-masks. It has been found that the coal from the shells of certain seeds and nuts, among them cocoanuts, chestnuts, horse-chestnuts, as well as peach-stones, has a much greater power of absorbing poisonous gases than ordinary charcoal from wood.

Throughout the United States peach-stones, cocoanut-shells, and the shells of other nuts are collected in large quantities by patriotic citizens, and it was not a difficult matter to arouse the interest of our boys in the effort of collecting a sufficient supply of peach-stones and nut-shells. One of our pictures shows a mass attack by a company of boys on a horse-chestnut tree laden with a profusion of the most beautiful red-brown nuts enclosed in their spiked shells.

Blackfish Land at Nantucket

THE school of blackfish stranded at Nantucket recently had probably been driven on the beach by killer-whales, their deadly enemies.

The blackfish, according to the Bureau of Fisheries, is not a fish, but a whale—or, to be more specific, a jet-black member of the dolphin or whale family. They suckle their young, and come to the surface to breathe.

They swim in large schools, and are found to the northeast of the Grand Bank and off the coasts of New England and the Middle States. A fifteen-foot blackfish weighs 800 to 1,000 pounds. Its oil is of commercial value, and the jaws yield a fine quality of machine oil.

The day after the visitation of blackfish at Nantucket, blackfish steak appeared on the local hotel menus, and proved excellent eating.

There's many a juicy steak and barrel of oil in this school of blackfish that were driven ashore by their deadly enemy, the killer-whales

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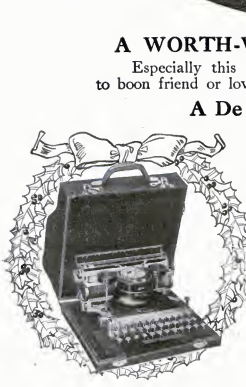

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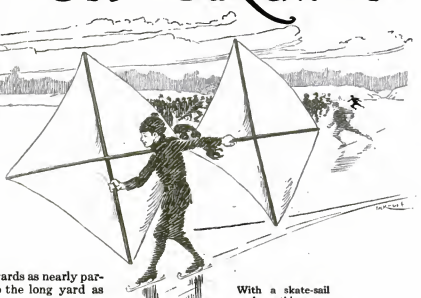
Sailing on Skates

By E. T. Keyser

Three sticks of wood and two pieces of muslin make an efficient skater's sail



With a skate-sail such as this every man and boy can be his own ice-boat

YOU may not be so fortunate as to own an ice-boat, but if you have a pair of skates you can make a skate-sail that will give you many of the joys of ice-yachting. The illustration shows such a sail. It is easy to make. The materials needed are:

1 piece of oak or ash 9 ft. long by 1¼ in. square.

2 pieces of oak or ash 5 ft. long by 1¼ in. square.

3 yards of unbleached muslin 30 in. wide.

2 round-head brass machine-screws 3 in. long by 3/16 in. diameter.

2 brass wing-nuts.

4 brass washers.

6 brass screw-eyes with ¼-in. eye.

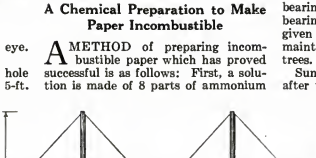
8 brass rings, ¼-in. opening.

With a ¼-in. drill make a hole through the center of each of the 5-ft. lengths, and 2 ft. 3 in. from each end of the 9-ft. length bore other holes. With the machine-screws attach the two yards or sticks to the long cross-bar, as shown in the illustration, and fasten with the wing-nuts, placing one washer between each screw-head and the wood, and another under each wing-nut. Set a screw-eye in the ends of each wood strip.

By referring to the illustration it will be seen that one diagonal of each sail is 5 ft., while the other is but 4½ ft. Make a pattern of these dimensions and cut out sails, allowing for a 1-in. seam all around. Sew a brass ring in each sail corner, and connect sails to spars and to each other by cords tied to these rings.

To furl for carrying, disconnect the sails from each other and from the ends of the long cross-spar. Roll them on their respective yards, and tie the rolls with a bit of cord; then loosen the wing-nuts a trifle, and swing the short yards as nearly parallel to the long yard as possible.

A sail of the dimensions given will serve a small boat on a very windy day. Increased sail area may be obtained by increasing the lengths of the spars. The maximum sail area is governed by the length of the vertical yards that may be kept from dragging on the ice when the sail is carried on one's shoulder.



A long bar of wood with two cross sticks to hold the pieces of muslin for making the sail

A Chemical Preparation to Make Paper Incombustible

A METHOD of preparing incombustible paper which has proved successful is as follows: First, a solution is made of 8 parts of ammonium sulphate, 3 parts of boric acid, and 2 parts of sodium tetraborate (borax) in 100 parts of water. The solution is heated to 120° F. The paper to be made incombustible is dipped into the solution and then allowed to dry. If the solution has been made up properly in the proportions indicated, results will be satisfactory.

Winter or Summer Pruning for Apple Trees

A HEAVY winter pruning will excite wood growth at the expense of fruit production. This is an important factor in the renovation of old apple trees that have stopped bearing. A light winter pruning of bearing apple trees should always be given to insure a sufficient growth to maintain the physical condition of the trees.

Summer pruning, when done just after the great growth of the season, will promote the formation of the fruit buds in trees that are prone to bear in alternate years. The summer pruning, or rather pinching back, consists in removing a small portion of the growing shoots. This should be practised only on those trees that have made a good growth.

To correct undesirable habits of growth, such as growing too upright or too spreading, cut back leaders to side shoots that are growing in the desired location. Free circulation of air and sunshine through the top will facilitate the formation of fruit buds, assist in coloring the fruit, and hasten the ripening process.

Cutting out diseased and dead wood will help to save the fruit spurs and hasten formation of new ones.

Water sprouts may be utilized to rework the top of the tree and to take the place of fruit spurs that may have perished —F. H. SWEET.

VITAL INDUSTRIES

NOW UNDER SAFE CONVOY

The government insures our ships and their precious cargoes as they ply towards France. But that does not save them from the torpedoes of the submarines.

The government therefore arms those ships and throws a protecting cordon of destroyers about them.

And now the same protective screen of destroyers has been flung around the vital industries of the country.

Vital industries everywhere must henceforth be protected against fire by automatic sprinklers, those infallible destroyers of fire, which in thirty-five years have won thousands and thousands of battles against their red enemy.

The vast establishments now to be protected are heavily insured of course. But keen old Uncle Sam knows the difference between mere insurance indemnity in money after a loss and the prevention of a loss. He could not wait for business men to slowly and painfully learn the lesson that fire losses (over $250,000,000 last year) are sapping our resources and threatening our productive capacity. In his wisdom he made business men do at once what their own best judgment would eventually have made them do, just as more than 25,000 business men have already done, namely —put their industries beyond the chance of ruination by fire.

This great act of conservation was born of the wisdom and deep understanding of the Federal Government. It is the harbinger of that certain day when State and Municipal officials will see that the same protection is a vital necessity in every school, hospital, asylum and other institutional building where human life is at stake. Proof that automatic sprinklers are the most potent factor in safe-guarding human life from fire, is complete and incontestable. For information on the protection of such properties, address The General Fire Extinguisher Co., 290 W. Exchange St., Providence, R. I.

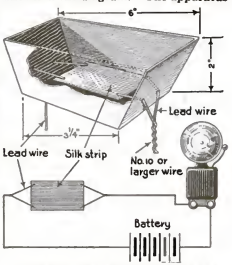
GRINNELL

AUTOMATIC SPRINKLER SYSTEM

The Factory-Assembled System

A Silk Cloth Makes Contact for a Rain or Snow Alarm

THE alarm consists primarily of a strip of silk cloth suspended between two wires or electrodes and these wires completing a circuit as shown in the diagram. The apparatus



The water dampens the cloth and makes the electric contact between terminals

is inclosed in a small box for protection from wind.

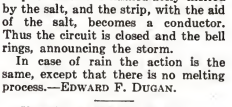
When it is desired to set the apparatus, simply spread a small amount of common salt on the silk, and after connecting as shown in the wiring diagram the alarm is ready for use.

If snow falls upon the suspended strip of silk it is immediately melted by the salt, and the strip, with the aid of the salt, becomes a conductor. Thus the circuit is closed and the bell rings, announcing the storm.

In case of rain the action is the same, except that there is no melting process.—EDWARD F. DUGAN.

Fuse Tongs Made of a Piece of Fiber

READERS who are familiar with the fuse that fits into clips know that it is a very dangerous piece of work to remove or replace a fuse without insulation between the fingers and the line. The accompanying



A slotted piece of fiber makes an insulator for the safe handling of electric fuses

sketch shows an inexpensive fuse tongs which is in many instances a life-saver.

Its construction is so simple, while at the same time it is so necessary an article to anyone who has occasion to remove or replace fuses, that it should be made a criminal act to be without one. It is made of fiber with the dimensions given. The fuse space and hole at the rear end are drilled out first, and a saw cut made to connect them.—MAURICE CLEMENT.

An Attractive Log Seat for the Garden

A COVERED seat of good design can be built entirely from a fallen tree in localities where timber grows. The straightest section of the trunk will serve as the seat, while from the better part of the branches can be made the arms, back, and other parts of the seat. The log, after having been cut to the desired length, is hewn to a flat surface on two sides, the upper side being dressed down much more painstakingly than the lower side, which will rest on the ground. About 18 in.—the height of a chair—should be the thickness of the log between the hewn top and the bottom.

The uprights, set in the holes one at each corner, are provided with shoulders to give good bearing. The illustration clearly shows the remainder of its construction. As may

A big log hewn and with shade supports attached to make a park seat

be seen, the bark has been removed from all of the parts, and the wood is dressed down slightly without destroying its character. Oiled and stained some neutral tint and covered with vines, it makes a very effective seat for the garden, especially under trees.

If the log lacks the necessary thickness it can easily be brought to the proper height by blocking it up.—C. L. MELLER.

An Acid Etching Fluid for Aluminum Surfaces

DILUTED hydrochloric acid best serves this purpose. Aluminum containing iron can be matted with soda lye, followed by a treatment of nitric acid. The lye dissolves the aluminum, and the nitric acid dissolves the iron. Aluminum bronze may be etched with nitric acid.

An Electro-Thermostatic Control for House-Heating Boilers

A home-made electric device to operate the draft doors by the temperature of the rooms

By E. F. Hallock

THE average house-heating steam boiler comes fitted with a highly efficient regulator which automatically opens or closes the draft according to the steam pressure, and tends to maintain that pressure constant without regard to the temperature of the portions of the house being heated. Where temperature conditions are such that a full head of steam is needed at all times in order to make the quarters comfortable, the pressure regulator for all-around efficiency and good service can hardly be improved upon.

Climatic conditions in many parts of the United States are such that steam is needed to keep the place warm one day, while on the next none is needed. These conditions call for a draft regulator that will be responsive to temperature fluctuations in the quarters being heated, with the added precaution that the pressure cannot increase above a certain predetermined maximum.

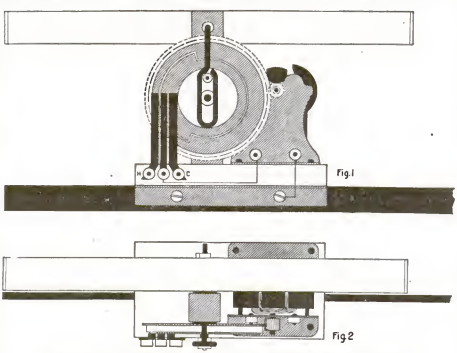
Pressure Regulator

In other words, what is required is a system that can be set to maintain the temperature at some fixed point, say 65 or 70 deg., and that will supply the heat needed at a pressure not to exceed 2 lbs. per square inch, this being the pressure most house-heating boilers are designed to operate.

In supplying the pressure regulator, the boiler manufacturer has done more than half the work for the man who would pattern his boiler after the foregoing suggestions. He has adequately taken care of the pressure-regulating end of our requirements, and has provided the mechanism for closing the bottom draft at the same time the check draft in the flue is opened, or vice versa. By taking advantage of this linkage, the necessity for making structural changes in the boiler or the flue system is done away with.

The pressure regulator consists of a very flexible brass bellows in communication with the steam dome of the boiler, so that the slightest pressure causes the bellows to extend. The free end of the bellows is connected to a long arm or lever, which in turn is linked to the check draft in the flue and to the bottom draft door, so that when the bellows extends the check draft is opened, admitting air directly into the flue above the fire, while the bottom draft is closed, cutting off the air from beneath the grate.

The pressure at which the drafts will operate is changed by shifting a sliding weight along the arm of the lever.



A small electric battery motor tilts the tube in which shot are placed to roll from end to end for operating the draft dampers on the furnace

How the Regulator Works

With the weight placed near its fulcrum, the moment of the force due to the weight is reduced and the pressure required is low. Sliding the weight out toward the end of the lever has the effect of increasing the pressure necessary to operate the drafts. Naturally, when the pressure falls off after the drafts have been closed a short time, the weight pulls the lever down until the fire brightens up sufficiently to raise the pressure again.

If the counter-weight is removed, and replaced by a device that shifts automatically according to the temperature of the heated rooms, midway it can be arranged either to close or open the drafts at will.

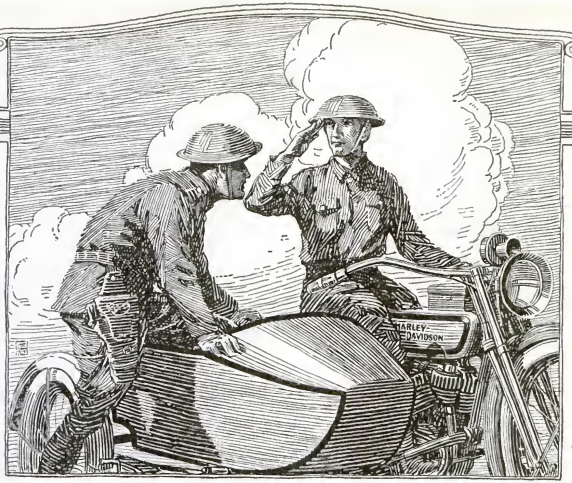
To Make the Apparatus

The simple apparatus shown in the elevation Fig. 1, in plan Fig. 2, and in application to the pressure regulator on the boiler (Fig. 3) accomplishes this purpose. It comprises a closed length of 1-in. square brass tubing, 11½ in. long, pivoted at its midpoint to a wood standard so that it can be tilted in either direction. Tilting the tube causes 2 lb. of BB shot with which it is about one third filled to shift from one end to the other. The shot, of course, supplies the shifting weight necessary to operate the lever. Tilting of the tubing is accomplished by means of a slotted lever formed integral with the shaft on which the tube is mounted. This engages with a pin mounted eccentric on a fiber-faced gear-wheel. The latter engages with the pinion of a small electric motor mounted on the same base as the standard that supports the tubing.

The whole apparatus is mounted by means of two clamp plates screwed to the under side of the baseboard and to the operating lever of the pressure regulator, so that the end of the balancing tube is just flush with the end of the lever itself.

The apparatus is so simple and the sketches so clear that little description is necessary. The apparatus from which the drawings were made was put together from scrap materials, the dimensions being chosen to fit the things at hand.

The baseboard is a piece of cypress 5¾ in. long, 2¾ in. wide, and ⅝ in. thick, and the standard is a piece of 1 in. square cypress 5 in. long over all, mortised into the base ½ in. from the



"To Battery E!"—"Yes Sir!"

WHEN the crisis came and the Army and Navy needed mounts that would carry an order with the speed of a "barked" command—mounts that would take punishment with the ruggedness of American morale—they turned to the motorcycle.

The Harley-Davidson

—in answer to the call—is now being made for the Government only, but some day we hope that you, too, may know the satisfaction of having in your personal service a motorcycle born in the same plant, groomed with the same care, and tuned up by the same testers as the one which at this moment may be tearing through a barrage to carry the report that "the 110th have taken . . . . . ."

Harley-Davidson Motor Company, Milwaukee, Wisconsin

"Ask the men in the service—they know."

front edge and 1⅝ in. from the left edge. The clamp plates are made of two lengths of sheet brass, right-angled and screwed to the under side of the baseboard, with their perpendicular sides 3/16 in. apart to accommodate the lever of the pressure regulator.

The shaft on which the balancing tube is mounted is a length of ¼-in. brass rod, looped to form a slot, as shown, and elbowed to journal in a babbitt bearing in the standard. Its outer end is threaded to take a thread tapped through both sides of the balancing tube and a lock-nut.

To Reduce Friction

After the whole apparatus has been set up and put in working condition, the lock-nut is screwed tight and soldered both to its shaft and to the balance tube to prevent its working loose and disarranging the apparatus. A washer is interposed between the tube and the standard to prevent binding, and another is soldered to the outer side of the shaft, adjacent to the standard bearing, to keep the shaft from working lengthwise into the standard.

The brass gear wheel 3½ in. in diameter is faced with a disk of fiber 3/16 in. thick and 3¼ in. in diameter, the composite wheel being mounted on a pin anchored in the standard, permitting the wheel to rotate freely. The pinion on the motor-shaft is 7/16 in. in diameter, and the motor is mounted on the right side of the baseboard, so that it engages perfectly with the teeth of the gear wheel.

One important consideration is that the operating lever on the boiler regulator tilts, and the length of the balancing tube should be such that it will be about twice the length to insure the shifting of the shot from one end to the other. In the apparatus under consideration the length of the boiler regulator arm is 18 in. and the tube was made 36 in. long. To bring about the proper results the pin was mounted ⅝ in. off center, so that its total throw is 1¼ in. To reduce friction to a minimum, a roller ¼ in. in diameter is fitted to revolve freely on the pin, and the slot in the operating lever is made 1½ in. long and ¼ in. wide, there being sufficient clearance to keep the boiler from binding at any point in its stroke.

Since it is necessary to have some device to turn off the current from the motor, a commutator is mounted on the face of the fiber disk, and the three brass brushes fastened to the baseboard at the left side make the proper contact when the heat-controlled relay swings from side to side. The commutator consists of two disks of thin sheet copper so shaped that the contact is made between the middle brush and one of the outside brushes, while the motor is tilting the tube in one direction and between the middle brush and the other one on the reverse motion of the arm. A little experimenting will be necessary, in setting the commutator, to get the operation of the motor so that it will do its work without keeping the arm tilting back and forth when once started.

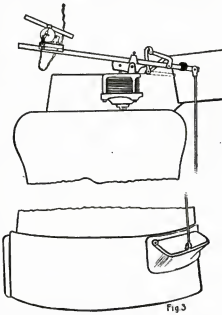


Fig 3

The tilting tube and its mechanism mounted on the draft damper operating the lever

The thermostat consists of 22 elements, of which 20 are exactly alike and the other two only slightly different. Each element consists of a bar of soft flat steel 4¾ in. long, ½ in. wide, and ⅛ in. thick, and a similarly sized piece of sheet brass—20-gage.

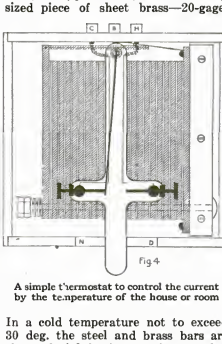


Fig 4

A simple thermostat to control the current by the temperature of the house or room

In a cold temperature not to exceed 30 deg. the steel and brass bars are clamped tightly face to face, and a 1/16-in. hole drilled about ⅛ in. from each end, and then they are riveted tightly, using a copper or brass rivet. The ends of these steel and brass bars are then soldered together for at least ¾ in.

If the brass bars buckle a trifle by the heat, pay no attention to it; this is just what is wanted to make the thermostat. The steel bar for the unit on the right is 5⅝ in. long, each end being drilled for fastening the bar to a wood piece with screws. The brass bar is soldered to it, as with the others, leaving a slight hang-over of the steel bar at each end. The left end unit has a steel bar 5¼ in. long, the upper end of which is forked for the reception of a piece of rack which is pinned in the fork when the thermostat is assembled. All solder projecting is filed, as well as the rivet-head, to make the surfaces smooth.

Centering and ¾ in. from the lower edge, a 3/16-in. hole is drilled through each unit for a bolt. The units are assembled as shown, the bolt passing through the wood base. A good stiff spring is placed over the bolt, and the nut is screwed down to apply plenty of tension. The bowing of the brass bars will cause the uppermost ends of the units to separate fanwise, and the lever action of the units themselves will enable you to take advantage of this extension, which increases as the temperature of the bars increase and decrease in changes of temperature.

The short length of rack shown pinned to the forked member of the thermostat engages with a pinion mounted on a shaft that carries a long spring brass lever. Also mounted on this shaft, so that it can be independently rotated, is a cross-shaped piece of fiber with two terminals in the shape of adjusting screws with lock-nuts, and they are so set that the swinging brass lever makes contact with either one or the other. Holes are drilled in the sides of the box, so that the air may freely circulate around the bars.

Simple Electrical Connections

The electrical connections are very simple. Each contact screw is connected to a binding post located on top of the case: the one on the left side or the low temperature side is connected at *C* and the other at *H* (Fig. 4.) The frame of the thermostat is connected to the central post *B*. These terminals are connected with like lettered parts on the regulator. The terminal *B* is connected to six dry cells in series, and the other battery terminal grounded to the nearest waterpipe.

The thermostat should be placed out of drafts and quite out of range of a radiator. At night it is necessary only to pull the fiber lever over to the left toward *N*. This will retard connection until very low temperatures are reached. The setting may be determined to suit requirements. With such an arrangement the basement need be visited only to place fuel on the fire or remove ashes.

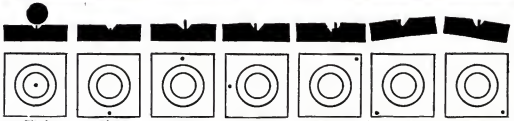


Fig. 1 Full open sight. Correct aim

Fig. 2 Fine sight. Low shot

Fig. 3 Too full. High shot

Fig. 4 Not centered. Left shot

Fig. 5 Not centered; too full. High right shot

Fig. 6 Sight inclined. Low left shot

Fig. 7 Sight inclined. Low right shot

How to draw a bead on a mark

IF you don't know the best way to sight a gun and plug the target square in the bull's eye, it will pay you to study the diagrams on this page.

These diagrams are taken from the book of instructions furnished to members of the Winchester Junior Rifle Corps.

How to align your sight

Figure 1 shows how a correct aim looks through an open sight. The top of the front sight should be on a level with the shoulders of the back sight. Always aim just below the center of your target.

Figure 2 shows how your aim looks when the front sight appears too low through the notch of the back sight, and the result you get.

Figure 3 shows the result of holding the front sight too high. Figures 4 and 5 show the result of not having the front sight centered.

Figures 6 and 7 illustrate a common fault with beginners, that of "canting" the rifle or tipping it so that the shoulders of the back sight are not on a level, horizontal line.

Try this method when you shoot

Get in on the Winchester Junior Rifle Corps medal contest. Follow the suggestion for correct aim in drawing a bead, and see how quickly you can qualify for a Marksman or a Sharpshooter medal.

It costs nothing to join the W. J. R. C., the national honorary organization which is teaching the skillful, safe use of firearms to America's boys and girls.

Just go to the W. J. R. C. Headquarters in your town. Your hardware or sporting goods dealer is probably a Local Representative of the W. J. R. C. Register your name, and get a membership certificate, a membership button and a rule book. You are then ready to compete for the medals.

This rule book gives you all the conditions of the contest, and tells you just how good a score you must make to win either the Marksman or Sharpshooter medal. One thing is important—all scores must be made with .22 *Caliber Winchester* rifles and ammunition.

A Winchester for Christmas

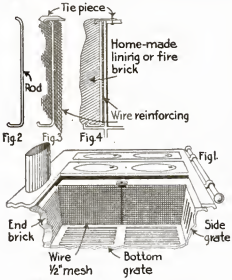
The best way for you to let your parents know that you would like a .22 Winchester for Christmas is to tell them that you have learned the W. J. R. C. rules for gun safety by heart. Then get them to read the rule book. When they know what the W. J. R. C. stands for it is a pretty safe guess that you will find a good old Winchester with your things when you wake up Christmas morning.

Remember that it does not make any difference in the medal contest whether you shoot with a low priced single shot Winchester rifle or a fine *repeater*. The accuracy of the Winchester is in the barrel. The same quality of steel and the same care in boring go into all.

Get started to-day. Go to the Winchester Junior Rifle Corps Headquarters and join. Then put it up to your parents to get you a Winchester for Christmas. If your Local Representative cannot give you full information, mail the coupon below direct to **Winchester Junior Rifle Corps, National Headquarters, 275 Winchester Ave., New Haven, Conn., U. S. A., Division 882.**

Reinforcing a Stove Lining for Fire-Brick

AT times it has been necessary to reline the fire-box in our kitchen range while awaiting the arrival of



Mesh wire used to reinforce fire-clay and to keep it from cracking

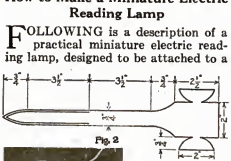
fire-bricks. The weight of the wet clay and poor retaining surface having caused a previous lining to crack and fall down, I reinforced the new lining with a piece of 1-4-in. mesh galvanized wire, fitted in as shown in Fig. 1. The ends of the wire were held by being slipped between the end brick and side grate, the upper edge being bent over the top plate.

To brace the wire firmly in place in the center, I used a 1-4-in. iron rod formed as shown in Fig. 2 and held by the tie piece Fig. 3 and 4. The lining was applied in the usual manner, and as it still holds, the use of the wire must be an advantage.

Should the lining eventually crack, the wire will prevent it from dropping out in pieces.—JAMES M. KANE.

How to Make a Miniature Electric Reading Lamp

FOLLOWING is a description of a practical miniature electric reading lamp, designed to be attached to a



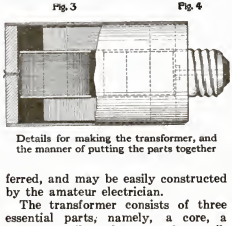
The pattern for the lamp and how it is used for illuminating a book

book or magazine. It can be constructed with very little trouble and trifling expense, and it has the advantage of illuminating the page no matter what position the reader assumes. Another point in its favor is that it does not cost much to operate.

In Fig. 1 the construction of the lamp is clearly shown. It consists of a single piece of brass (No. 17 gage) cut to the dimensions given in Fig. 2. The shade is closed at each end by the semicircular pieces, which are bent down on the dotted line, as shown, and then soldered. It should now be polished with fine emery cloth or steel wool, and later lacquered.

The light is furnished by a 4 c. p. 6-volt bulb. The brass base of the bulb is soldered directly to the under side of the shade, thus doing away with a rather bulky receptacle. Obtain about 10 ft. of No. 18 gage green silk lamp-cord, and solder the two terminals of the lamp to it. A small fiber bushing should be provided for the hole in the stand of the lamp, to prevent the cord being chafed and cut through.

The current to operate the lamp may be supplied either by batteries (preferably dry cells) or by a small transformer connected with the regular circuit. The latter is to be preferred, and may be easily constructed by the amateur electrician.



Details for making the transformer, and the manner of putting the parts together

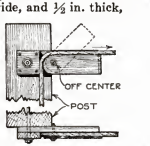
The transformer consists of three essential parts, namely, a core, a primary coil, and a secondary coil. The core is of the usual laminated construction as shown in Fig. 3, and is composed of enough pieces of thin sheet-iron, cut as shown by the heavy lines, to make a pile ½ in. high.

To make the coils, proceed as follows: Make two square spools of 1/16-in. fiber of the dimensions given in Fig. 4. Wind one spool full of No. 36 gage enameled magnet wire, and the other full of No. 36 enameled wire. This will give approximately 6 volts on the secondary when operated on a 110-volt circuit of alternating current. These are respectively the primary and secondary coils. Each should be protected from injury by several layers of insulating tape.

The transformer can now be assembled and placed in a small case as illustrated. The transformer is so small that it may be screwed to the lamp-socket by means of the attachment plug shown. The two primary leads should be connected to this plug and the two secondary to the lamp-cord. If these directions have been carried out carefully, a novel lamp will be the result.—LESLIE SWINDLE.

A Firm-Grip Clothes-Line Holder

TAKE a straight board about 1 ft. long, 4 in. wide, and ½ in. thick, and nail a small block on oneend. Cut one end of a shorter piece in a half circle, and bore a hole through to one side of the center mark, also bore a hole in the first piece at a point where it will, when the two



A cam-shaped lever holds the line tightly

pieces are held together with a bolt, bring the curved end close to the small block edge. When the strain is applied to the rope, it will cause the movable strip to grip it tightly. To loosen the line pull on the movable strip. The holder is fastened to the post with bolts.—ELWIN E. STARR.

Truing Up Worn or Mutilated Screw-Driver Blades

ONE of the most common errors among mechanics seems to be made in the truing up of screw-drivers that have been worn or mutilated. The average user seems unaware of the actual construction of the working end of a screw-driver. When he thinks the tool needs fixing, he simply takes a file and removes some of the stock on the end until it has the appearance shown in Fig. 1.

It stands to reason that when the screw-driver is applied to the screw-head the curved sides *A* and *A'* will afford very little grip, and will slide out of the screw-head slot without doing any apparent work. Good screw-drivers are made as shown in Fig. 2, and should always be kept the same way by filing a slight hollow just

The blade of a screw-driver should be "hollow ground" to hold in the slot of the screw

back of the working surfaces *B* and *B'*, which act as levers bearing against the sides of the screw slot, thus preventing the driver from slipping out and away from the work.—FRANK W. HARTH.

FIGHT *or* Join the Industrial Aircraft Service

YOU may not be free to get into the actual fighting, but you can still give valuable service to your country. Join the Industrial Aircraft Service and you'll not only be serving where you're most needed but you'll be laying the foundation for your future success.

Here is both Duty and Opportunity.

Here is your chance to get into essential war work, serve your country and make a good connection in the industry that's fast becoming one of the foremost in the world.

The Aircraft Industry is more than a wartime emergency. The Aerial Mail Service has established the definite commercial value of the Aeroplane. After the war there will be opportunities aplenty for men who make good in the Industrial Aircraft Service *now*.

An Opening for You in One of America's Foremost Aircraft Plants

At present our plants in New Brunswick (N. J.) and Long Island City are engaged solely in the manufacture of Aeroplane Motors for the Government. To meet our ever increasing schedule of production we must have the man power to operate the machines in our various departments.

We want your help. *We want skilled mechanics, machine operators, inspectors, draftsmen, etc.*

We will pay good wages for the right men.

Our Offer to Men Not Technically Trained

You do not have to be a skilled mechanic to get started with us.

If you have the right spirit and the determination to learn, we will take you on and train you at our expense in our School of Instruction.

Not only will we give you, free of charge, a full course of practical instruction under the supervision of competent instructors, but we will pay you while you are learning.

When you have completed the course which takes about ten days, we will pay you full wages prevailing in the factory.

Living Conditions Good

Living conditions in New Brunswick and vicinity are being bettered every day. Every Wright-Martin man will be able to count on a comfortable and congenial place to live. Moreover, the Government is now building 200 houses especially for war workers at Wright-Martin and other factories.

The company provides for social and recreational activities for everyone. With baseball, football and track athletics, picnics, concerts and dances, there need be no dull times for you or your family in New Brunswick.

Earn While You Learn

To men without any previous technical training we give a thorough and intensive course in our School of Instruction. We pay you during your period of instruction a rate higher than that of many actual shop rates until you are fully trained to hold down a regular job at full factory pay. Period of instruction takes from four to ten days

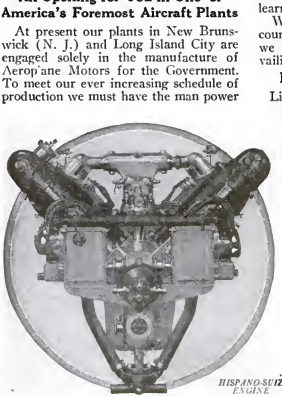
One Hour from New York City

New Brunswick is just about one hour out of New York on the Pennsylvania. It is within short commuting distance of Newark, Elizabeth, Trenton and Philadelphia.

Your Duty Is Here

In fairness to yourself you can't afford to pass up this opportunity to advance yourself and serve your country, too.

Write, phone or apply in person to Employment and Welfare Department, Wright-Martin Aircraft Corporation, New Brunswick, N. J., and Long Island City, Starr and Borden Avenues.



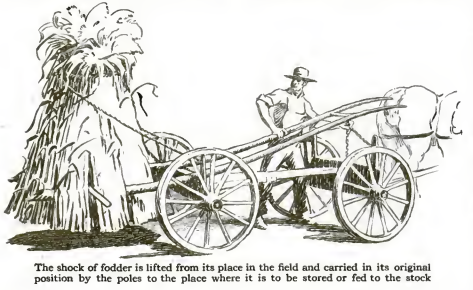
HISPANO-SUIZA ENGINE

Wright-Martin Aircraft Corporation

New Brunswick, N. J., U. S. A.

The Use of Wagon-Poles for Removing Shocked Fodder

THE device here described has been in use on our farm for years, and with its help the usually hard task of removing shocked fodder from a field that is to be plowed or seeded has been reduced to a one-man job.



The shock of fodder is lifted from its place in the field and carried in its original position by the poles to the place where it is to be stored or fed to the stock

Remove the bed from the wagon, and put in its place two stout ash poles 13 ft. long, made to fit the rear bolster with two cross-pieces that fit loosely in front and rear of the bolster. These cross-pieces also project a few inches beyond the poles on each side, to keep the poles from slipping. The front sides of the poles are also held together by a shorter cross-piece, the two poles coming together in V-shape at the front, and being just long enough to project a few inches beyond the front bolster of the wagon.

This pole frame is then set loosely in its place in the rear bolster, so that it can be teetered up and down. Now, with a short chain loop attached to the front bolster, a 12-ft. rope fastened to the rear bolster ready to throw around the fodder shock, and with a smooth light pole 6 ft. long, 2 in. thick, which has been sharpened at one end, we are ready to haul in the fodder. This work must be done before the ground freezes or during a thaw.

Back the wagon up to the shock, with the poles in position as shown, backing forcibly against the shock until the sharpened end of the V-pole either straddles or penetrates the shock, and until the rear bolster of the wagon comes up snugly against the shock. Now thrust the small, sharpened pole through the shock, with its two ends just above the larger poles, throw the rope around the top of the shock and fasten it, then throw your weight on the long lever formed by the front end of the pole, and fasten it down with the short chain to the front bolster. Drive directly to the feed yard, and back the shock into the place where it is to stand, release the lever and other fastenings, and drive away, leaving the shock intact, tied, and standing upright, just as it was in the field. In a very short time a field may be cleared in this manner and all the shocks set closely together in a feed yard.

It is a long, hard job to tear the shocks apart, load them on a rack, and then set them up again; and, even at that, they never can be made weather-tight, as they were when cut green and set up and tied. This device makes it possible for one man to move these shocks intact wherever desired and without any unnecessary outlay of time.—A. A. JEFFREY.

A Tool- or Utensil-Rack Made of Clothes-Pins

THE accompanying illustration shows a useful tool-rack which is cheap and easy to make. It consists of two rows of clothes-pins clamped firmly between two flat iron or wood bars.

The bars are swiveled on the end

The body of each wood pin is clamped between two bars for making a tool-rack

of a bracket fastened to the wall.

This little device can also be used for a tie-rack, or for handkerchiefs, or for ladles in the kitchen.—E. SWARTZ.

How a Brick Fire-House Was Built on Swampy Ground

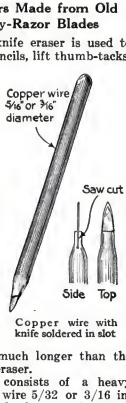
WE are taught that a house built on sand will fall, but modern methods have almost discounted this. A two-story brick fire-house 40 by 80 feet was built on swampy land in 1910 in a certain city, and up to the present time it has shown no signs of settling, though it houses the heaviest kind of apparatus. It was not until excavation for the foundation was well under way that the soil was discovered to be swampy—water oozed out continually.

The expense of driving piles being too great, light crib-work was made and set in the water, and on this a few old rails laid as a reinforcement for the concrete. Then the water was pumped out and oil poured in the foundation ditches. On top of this, a 6-inch layer of concrete was carefully placed.

Before the work was completed the water had risen; but the oil on its surface prevented it from softening the new concrete. This gave the latter a chance to set, and the rest was easy.—DONALD A. HAMPSON.

Knife Erasers Made from Old Safety-Razor Blades

THE usual knife eraser is used to sharpen pencils, lift thumb-tacks, and do general service as a knife, with the result that the point is seldom of any use as an eraser, particularly on tracing linen.



Copper wire with knife soldered in slot

Realizing that only the point is of any use for this purpose, I have for several years used very small erasers made from old safety-razor blades, the steel of which is very hard and maintains its edge much longer than the ordinary knife eraser.

The handle consists of a heavy piece of copper wire 5/32 or 3/16 in. in diameter and about 4 in. long. Make a saw cut in one end from ½ to ½ in. deep. Place a safety-razor blade in the cut, and hammer the two sides together. Remove the blade and taper off the end neatly. With a pair of pliers break off a piece of the blade about ½ in. long, and solder it into the slot by placing a small piece of solder in place and heating the copper wire in a flame until the solder runs, after which immediately withdraw it so as not to draw the temper. The steel may then be readily shaped up on an emery-wheel and sharpened on a stone, care being taken not to overheat it in grinding.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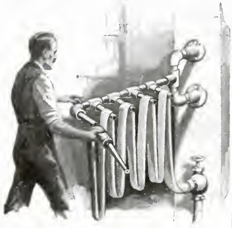
A Hose-Rack Made of Pipe and Fittings

THERE are many kinds of racks for fire-hose. A new kind is shown in the illustration; a home-made affair.

This rack consists of pipe and fittings so arranged that it can be swung against or out from the wall. As many pins or pipe extensions may be used as are necessary to hold the length of hose. The hose is laid in flat turns over the extensions.



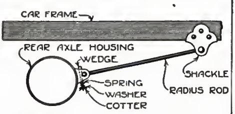
Gas-pipe arranged so that a hose may be laid flat on the extensions, ready for use

It is easily taken from the rack in case of fire.—JAMES E. NOBLE.

Holding an Automobile Radius Rod with Wedge and Cotter

IN many of the older automobiles the radius rods are used to take the drive. These rods usually have a ball-and-socket joint at the forward end with adjustment, and the rear ends are connected to the rear axle-housing with a pin or bolt. Since this joint is very difficult to protect with a leather boot and grease, it soon becomes worn and is the source of a great deal of noise.

New pins can be fitted with bushings, but these also soon become worn. To secure a more permanent repair, a wedge of steel 4 in. long and ½ in. wide, tapered to about ⅛ in., is driven tightly into place between the end of the rod and the axle-housing. The exact size of the wedge will depend on conditions. The wedge may be kept in place with a coil-spring and cotter.—P. P. AVERY.



A wedge placed in the joint of a radius rod to take up wear and prevent rattle

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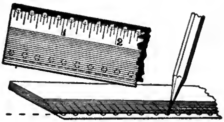
Use Piece of Old Moving-Picture Film to Make a Dotted Line

A PIECE of discarded moving-picture film, fastened with glue to the edge of a rule, so that the



The holes in the film make an even length of line for each dash in the line

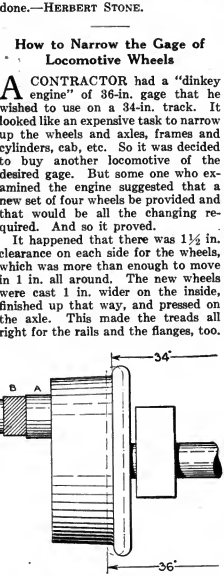
perforations project, aids materially in making dotted lines accurately and evenly on a drawing.

The illustration shows how this is done.—HERBERT STONE.

How to Narrow the Gage of Locomotive Wheels

A CONTRACTOR had a "dinkey engine" of 36-in. gage that he wished to use on a 34-in. track. It looked like an expensive task to narrow up the wheels and axles, frames and cylinders, cab, etc. So it was decided to buy another locomotive of the desired gage. But some one who examined the engine suggested that a new set of four wheels be provided and that would be all the changing required. And so it proved.

It happened that there was 1½ in. clearance on each side for the wheels, which was more than enough to move in 1 in. all around. The new wheels were cast 1 in. wider on the inside, finished up that way, and pressed on the axle. This made the treads all right for the rails and the flanges, too.



Casting new wheels to reduce the width of the gage on a contractor's engine

The treads, however, stuck over the rail on the outside, but there was no objection to this, for in so doing it put the pins in line with the main rod, *A*, and the side rod, *B*, and there was no disturbance of saddles, cylinders, frames or springs. The dotted line shows the original position of the wheels.

Simple Designs for Sheet Metal Working

XIX.—Development of Patterns for a Ship's Ventilator

By Arthur F. Payne

Director of Vocational Education, Jamestown, Pa.

EVERY student of pattern drafting sooner or later has the desire to develop the patterns for a ship's ventilator, and, judging by the number of requests that have come from our readers, they are no exception to the rule. In following out the logical sequence of the present series, this is the proper time to demonstrate this particular problem. Many students of pattern drafting have difficulty with the ship's ventilator problem because they have not prepared for it by doing the problems leading up to it. It is hoped that all of you who attempt this problem have worked out the problems in the last four chapters; otherwise this problem may not be readily worked out.

The three-piece ship's ventilator (Fig. 1) is a very simple form of ventilator. It has been simplified so that the method of developing the pattern may be more easily followed. Fig. 2 shows a more complicated form of ventilator.

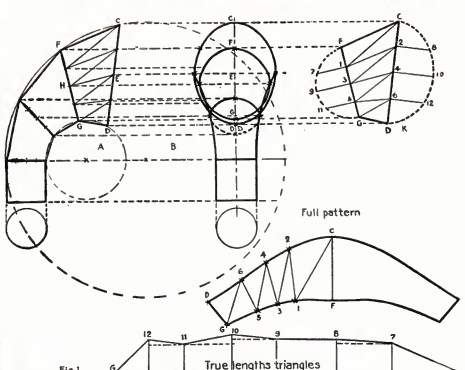
The front view *A* is drawn as desired; that is, there are no set rules governing the number of sections, the diameter, or the curvature. The best way to begin is to draw a free-hand outline of the ventilator in light pencil lines. The outlines of both back and throat should be parts of circles, as shown. The crosses mark the centers of the throat and back circles.

Next, divide the throat and the back into the number of sections desired. In this case there are three sections. These sections are equally spaced on the circles. Notice that this ventilator changes its form from round to oval.

To draw the end view *B*, first draw the center line, the bottom view circle, and the straight piece of pipe. Next, project over from the front view the length of the line *C—D*, and the center of the line *E*. Now draw the large oval mouth of the ventilator. Draw it any shape you choose. From the widest part of the oval mouth, where the line *E* passes, draw the curved side lines down to the straight part of the pipe. Now project over from the front view the line *F—G* and the center point *H*. Draw the oval, making the widest part rest on the center line *H* where it crosses the curved side line. Do exactly the same with the other joint line, and your end view *B* will be complete.

Laying Off the Triangles

We now can proceed to lay out the pattern for the large section. We must first lay off the triangles. There are two ways of doing this. The joint line may be divided in the front view into equal parts and projected across to the end views, as has been done in Fig. 1, or the process may be reversed by dividing the end view oval into equal parts and projecting it across to



A three-piece ship's ventilator makes an ordinary form, and it is so simplified that the method of developing the pattern may be more easily followed

the front view, as shown in Fig. 3. To avoid confusion and to make the drawing less complicated, the large section to be developed has been transferred to the right, as shown at *K*. With a piece of tracing paper this can be done very easily. Use the tracing and carbon paper to transfer one half of the ovals of the section from the end view *B* to the section *K*, as shown by the dotted lines.

Number the points of the triangles as shown, and draw lines at right angles from these points to the dotted ovals. Notice that the even numbers are on the line of the large oval and the odd numbers are on the small joint oval.

To Lay Out the Pattern

Now, to lay out the pattern, first draw the line *C*—*F* of the pattern

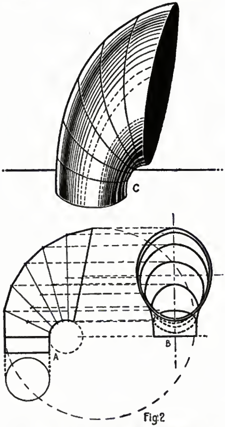


Fig. 2

The method of developing this pattern is the same as for the three-piece ventilator

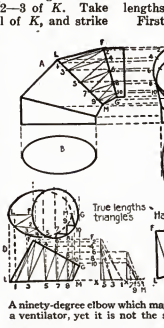
equal to *C*—*F* of *K*, as it is a true length line. Next, get the true length of line *C*—1. In Fig. 3 the old method of obtaining the true lengths of lines has been used, and will be easily understood by those of you who have followed this series. Fig. 1 offers an opportunity to illustrate a different method based on the same principle.

Draw the base line *C*—*G*, set off the line *C*—1 of *K* as *C*—1 on the base line. Draw 1—7 of *K* at right angles to the base line. Line *C*—7 will be the true length of line *C*—1 of *K*. Take the distance *F*—7 of *K*, and strike an arc *F*—1 of the pattern; take the true length line *C*—7, and strike an arc from *C* of the pattern, and then point 1 of the pattern is located.

Set off distance 1—2 of K as 1—2 on base line, draw 2—8 of K as 2—8 at right angles to the base line; 7—8 of true lengths is the true length of 1—2 of K. Take the distance C—8 of K and strike arc C—2 of pattern, and point 2 of the pattern is located. The dotted lines on the true lengths are drawn merely for the purpose of showing you the triangle. The line 7—8 is slightly longer than 1—2, because line 2—8 is longer than 1—7.

Set off the distance 2—3 of K as 2—3 on base line, and draw 3—9 of K as 3—9 at right angles to the base line; 8—9 of the true length is the true length of line 2—3 of K. Take 7—9 on dotted oval of K, and strike the arc 1—3 on the pattern. Take 8—9 of the true lengths, and strike arc 2—3, and the point 3 on the pattern is located.

Follow exactly the same steps with 3—4, 4—5, 5—6, 6—G, and G—D; then connect the points with a free-hand curve, and one-half of the pattern for the longest section of the ventilator is completed. Fold over the half pattern on the center line to get the complete pattern. Make due allowance for seams and laps, as explained in the beginning of this series.



A ninety-degree elbow which may be used as a ventilator, yet it is not the same design

The second and third sections are developed in exactly the same manner as demonstrated for the large section. The pattern for the round pipe is developed by means of parallel lines, as demonstrated in the first article of this series.

A Better Ship's Ventilator

Fig. 2 shows a much better form of ship's ventilator. The front view is shown at A and the end view at B, looking into the mouth of the ventilator. A perspective view is shown at C.

The method of developing the patterns for this ventilator is exactly the same as for the three-piece ventilator. After you have worked out the three-piece ventilator you will be able to do the six-piece one easily.

Fig. 3 shows the oval to a round ninety-degree elbow, which is a different application of the methods used in the ship's ventilator problem. In fact, it could be used as a ventilator, although it is not quite the same design.

As mentioned before, the front view is at A, the bottom at B, and the end at C, looking into the round end of the elbow. The end view is drawn by projecting across from the front view in exactly the same way as described for the three-piece ventilator. You will notice, as these patterns are worked out, that the methods and principles are the same as for the ventilator, but that we have reversed the problem and used slightly different methods. For instance, the triangles on A were laid out by dividing the circle and oval of the end view B into equal parts and projecting across to the front view; also, the oval is at the bottom instead of at the top. The transferred section D shows a regular top view instead of the dotted half views shown in Fig. 1. The old method of finding the true lengths is used in the elbow problem.

First, draw the front view and the oval B as desired. Obtain the end view C by projecting across from the front view. Lay out the triangles by projecting across from the front view. Remember that the greater the number of triangles used the more accurate the pattern will be. Transfer the section D as shown. Project upward and get the lengths for the top view. Obtain the widths for the top view by transferring the widths of the same numbered points from the end view C.

Obtain the true lengths in the same manner as described in previous articles, that is, by erecting a right angle and projecting over the heights of the numbered lines to the right angle, then setting off on the base line the distance between the same points on the top view. You will then have the true length of that line. The steps taken in laying out the pattern are, first, draw the right angle for the true length triangles; second, project over points F—2—4—6—8—10 as shown. It will be noticed that points 6—8—10 are carried over to a second triangle. This is because the lines would have overlapped and caused confusion if we had used only one triangle.

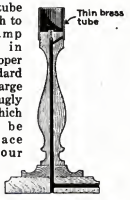
Lay off line L—F from the section D as L—F of the pattern, then take distance L—1 of top view and lay off as L—1 of pattern. To get the true length of the line F—1, set off F—1 of top view as X—1 of the true length, and the F—1 of the true length is the true length line; set it off as F—1 of the pattern. Next set off F—2 of the top view as F—2 of the pattern, and get the true length of 1—2 from the true length triangle, as described several times before in this series. Repeat the process until the half pattern is complete. Fold the pattern on the center line to get the complete pattern.

The last four articles in this series contain the most difficult processes and problems in sheet metal pattern drafting. If the student of this series can work out and understand the principle involved, the problems presented after this will be comparatively easy. If any difficulties are encountered he is earnestly advised to review the last four articles, since they serve as a preparation for these problems.

(To be continued)

A Simple Socket for Small Electric Battery Lamps

IN making small desk lamps and electric candles, the ordinary socket is too difficult to attach and is needlessly cumbersome. A good substitute is to bend a thin strip of brass around the end of an incandescent lamp, and to solder the ends so as to form a tube just large enough to permit the lamp being pushed in tightly. The upper end of the standard should be just large enough to fit snugly into this tube, which should then be fastened in place with about four brads. The wiring is run up through a central hole, one wire terminating at a wood-screw in the center, and the other running out to one side, where it connects with the brass tube.

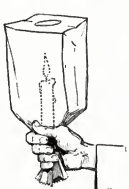


A candle-stand for a small electric globe

If the tube is made so that the lamp fits in quite tightly, and if it is put in the first time as if it were being screwed in, the thin brass will become slightly indented, the effect being that of a regular socket.—JOHN D. ADAMS.

A Bicycle-Lamp Made of a Candle and a Paper Bag

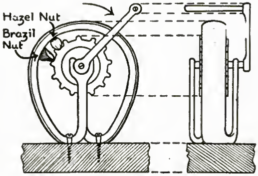
IN the Southern States bicycle-riders use a paper bag and a candle to furnish light for night riding. A small hole is cut in the bottom of the bag for ventilation, and a candle is placed in the open end, which is then folded about it and held in the hand.


A paper bag with candle inclosed for a bicycle light

When lighted it throws a beautiful yellow light, and makes a simple and efficient lamp which complies with the law.—L. B. ROBINS.

A Nut-Cracker that Prevents Crushing the Kernel

It is the fashion nowadays to put nuts on the table in a wooden bowl, in the center of which is some kind of nut-cracking device. Some kinds of nuts, Brazil nuts for instance, are very



A spur gear or a sprocket wheel used for cracking the shell of a nut

hard to crack, and nuts that are large frequently have the kernel broken up into fragments. The following device permits the breaking of any kind of nuts quite easily. It is made of a pinion mounted on a crank, and of a simple, strong iron bar forged in the form shown in the illustration. Holes are punched in the base of the bar to fix it with screws on a wooden bowl, and the two ends are shaped into a bearing to receive the axle ends.

The nut, being held between the wheel and the circular bar, is cracked when the handle of the crank is moved down, and the shell is broken without the kernel being crushed. By turning the crank in the opposite direction, the shell and kernel are liberated. Both sides of the apparatus can be used.

With a pinion of the ordinary model, it is necessary to cut out every other tooth, in order to permit the sure grip of any kind of shells. That can be done with a chisel and a file. Instead of a flat iron bar, it is better, but not absolutely necessary, to get a bar slightly bent in its width, and to place the concavity toward the pinion. Lacking an ordinary wooden bowl, it is very easy to make a bowl out of a short log, preserving the bark, and hollowing out the inside with a gouge, finally varnishing it.—H. Rousset.

Making Use of Both Lines on a Double Clothes-Line

In city houses, where pulley clothes-lines are used, there is difficulty in getting enough clothes-line space. With

An extra line on the two pulleys for holding the smaller things for drying

the construction of the device here illustrated, one laundress uses both lines, the top one for small articles.

A small line, the length of the stretch between the pulleys, is placed on the upper strand of the pulley-line by means of a number of rings, so as to slip easily along the wire. There is a lock-nut on a piece of brass tubing at *A*, and the end *B* is fastened to the lower strand.

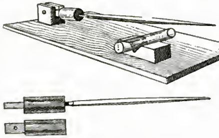
To begin with, the end *A* is left loose, and the line reeled in until *B* is also at the end *A*. Then the heavy clothes are pinned to the lower strand of the pulley-line and the small articles to the suspended line. Both are filled up at the same time, piece by piece.

When the lines are full, the end *A* is clamped to prevent the wind disturbing the suspended line.—Ernest A. Hodgson.

A Home-Made Tool to Cut Glass Tubing

A handy laboratory tool for cutting glass tubing of large diameters can easily be constructed with a three-cornered file. The drawing depicts all the constructional details necessary.

When using the device, press lightly on the file with one hand and turn the tubing with the other. After the glass is scratched all the way around, it may be snapped in two by placing



A three-cornered file mounted on a base, so that one corner can be used in marking the glass tube

the thumbs on each side of the scratch and exerting a backward pressure.

It is quite impossible to break tubing over 1 in. in diameter by this means, as the break will not follow the scratch. When breaking tubing over ½ in. in diameter, a towel should be wrapped around it so the hands will not be lacerated should the tube happen to splinter.

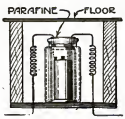
When the file becomes dull on one corner it can be turned over.—Raymond Francis Yates.

Removing Burr Formed by Sawing Off Bolt Ends

If it is necessary to saw off a bolt end through the threads or to file down the end, take the precaution to run a nut on the threads some distance above the proposed cut. By running this nut off when the operation is completed, the burr left by the cutting process is removed, thus avoiding a great deal of trouble in starting a new nut.—H. J. Gray.

Encasing a Dry Battery Cell to Keep Out Dampness

THE ordinary dry battery rapidly loses its strength when it is placed in a damp place, and because of this a door-bell battery located in a basement will not last as long as one situated elsewhere. Yet in some houses the basement or cellar is the only convenient place for the cell.

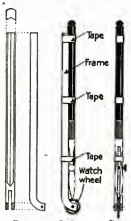


A glass fruit-jar inclosing the battery

A certain circuit caused considerable trouble by its battery giving out frequently. The battery was located under the conditions mentioned. A fruit-jar was secured that would just receive the battery cell and of a height to allow 1 in. or more space at the top. A stopper was made to fit, with two holes drilled to allow the connecting wires to enter. The whole top and around the wire holes was then sealed with paraffin. The jar, with its contents, was placed on the battery shelf in the basement. The battery gave good service for a single bell for many months.—F. W. BENTLEY.

How a Draughtsman Can Make His Own Dotting Pen

DRAWING instruments are expensive as a rule, and the so-called dotting pen is no exception. Here is one, however, that will cost nothing but a few minutes' time. All that is required is a piece of cigar-box wood, a gear wheel from an old watch, and a small piece of adhesive tape.



A pen attachment that has a gear as a dotter

The cigar-box wood is cut into a small frame as shown by the front and side view of Fig. 1. A V-shape groove is cut in the front so that a ruling pen may rest securely against the frame. A slot for the gear wheel is then cut and the wheel put in place. Next, an ordinary drawing pen is fastened to the frame by two or three pieces of adhesive tape, as shown in Figs. 2 and 3. Care should be taken that the pen is fastened so that the tips on the gear wheel just catch the ink.

The pen is now inked in the usual manner, and when the wheel is run along the paper a series of perfect dots is the result. Different sized wheels may be used to suit the work.—ALBERT E. JONES.

Electrical Devices and How They Work

XII.—Light and electric illumination

By Peter J. M. Clute, B. E.

IN order to comprehend more clearly the subject of electric illumination, a brief discussion of the fundamental theory of the nature of light and its transmission will not be amiss. Before any of the great natural agents can be utilized most effectively, some knowledge of their principal characteristics should be gained.

Light is a form of radiant energy. Not all the energy radiated from a luminous body is light, some appearing as heat energy; but that portion which affects the sensation of light is called light. The prevailing view about the nature of light is that it is a transverse wave motion or vibratory disturbance in ether, which is an all-pervading medium, filling all space and even penetrating between the molecules of ordinary matter. These disturbances are probably not transverse physical movements in ether; by transverse vibrations are meant those that are at right angles to the line or path of motion. Diagrammatically these are shown in Fig. 1.

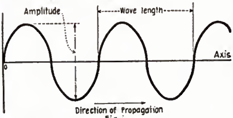


Fig. 1

A curve showing a transverse wave motion or vibratory disturbance in ether

Transparent, Translucent, and Opaque Bodies

Light radiation travels from its source of propagation in straight lines, with a speed of 186,000 miles per second, as long as it remains in a homogeneous medium. When some intercepting medium is placed in the path of the ray of light, it is either reflected, refracted, or absorbed. A body is transparent when it allows light rays to pass through it with so little loss that objects can be easily distinguished through it, as in the case of clear glass, air, or pure water. Translucent bodies transmit light, but so imperfectly that objects cannot be seen distinctly through them, like paper, some kinds of glass, or milky and muddy waters. Other bodies, such as blocks of wood or metal, transmit no light, and these are opaque. Opaque bodies are of two kinds—those that turn back the light at the surface, and those in which light penetrates and is absorbed and transformed into heat. The opacity of metals is largely of the first kind, while that of other substances is due to absorption.

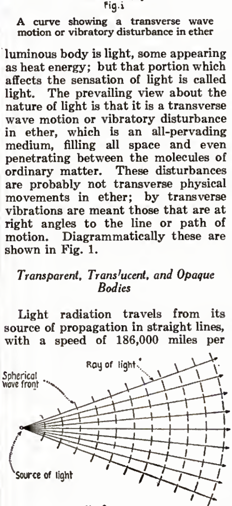


Fig. 2

When light comes from a point the rays diverge radially from the source

Light is propagated outward from the luminous source in concentric spherical waves. Rays are the radii of these spherical waves, and they are, therefore, normal or perpendicular to them, and mark the direction of propagation. When the light source is at a great distance, the rays incident on any surface are parallel; a number of parallel rays form a beam. When light comes from a point, the rays diverge radially from the source, and the wave fronts are spherical segments having the *source at their center*. Such a beam is divergent, and its waves enlarge as they advance, as shown in Fig. 2. By means of a lens or curved mirror, a beam of light may be made to converge toward a point which is called the focus, in which case the wave fronts must be concave spherical surfaces which contract as they approach the focus, as in Fig. 3.

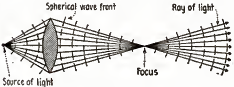


Fig. 3

A beam of light made to converge toward a point with a lens or curved mirror

Umbra and Penumbra

When an opaque object is interposed between a light source and a screen, the space behind the object from which the light is excluded is called the shadow. The figure on the screen is a section of the shadow. The darkest part of the shadow, called the umbra, is caused by the total exclusion of the light by the opaque object; the lighter part, caused by its partial exclusion, is termed the penumbra. When the source of light is a point, as in Fig. 4, the shadow will be bounded by a cone of rays tangent to the object, and will have only one part, the umbra. When the light source is an area, such as in Fig. 5, there exist both umbra and penumbra on the screen.

If the source of light in Fig. 6 is a

point, it is evident that a surface *S1*, if moved to *S2*, twice as far from the source, will intercept only one fourth as much light as in its original position; if the distance from its source is increased three times, it will intercept only one ninth as much light. Hence, the intensity of illumination or the quantity of light received on a unit of

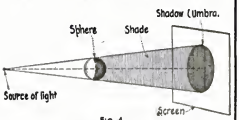


Fig. 4

An opaque object interposed before the light to make a shadow on a screen

surface varies inversely as the square of the distance from the point source.

If the medium is such as to absorb some of the light, the decrease in intensity is greater than that expressed by the law of inverse squares. This law also assumes that the source of light is a point, and that the receiving surface is at right angles to the direction of the rays. When the surface on which the light falls is inclined, the intensity is still less.

How to Measure Light

The measurement of the relative amounts of light given out by two sources is called photometry. A photometer is an instrument for comparing the intensity of one light source with that of another. The principle applied is a consequence of the law of the intensity of the illumination; it is that the ratio of the intensities of the two lights is equal to the source of the ratio of the distances at which they give equal illumination.

The simplest form of photometer is that devised by Bunsen. It consists of a screen of white paper having a spot at its center made translucent by applying a little paraffin, supported on a graduated bar between a standard candle and the light to be compared

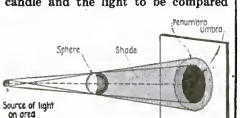


Fig. 5

If the light source is an area, both umbra and penumbra exist

with it. In Fig. 7 is shown a diagram of the Bunsen photometer. The translucent spot transmits light freely, and therefore, if the paper is lighted on only one side, the illuminated side will appear bright with a dark spot at the center, while the side away from the light will be darker with a bright central spot.

If both sides of the screen are equally

illuminated the spot disappears. The intensities of the lights are then proportional to the squares of their distances from the screen. The luminous intensity or candle-power of a light source is a measure of the light-producing power of the source. Candle-power is the light-giving power of a sperm candle, adopted as a standard unit light source, and burning 120 grains per hour. This standard develops an apparently luminous intensity of approximately 1 candle in a horizontal direction.

Angles of Incidence and Reflection

When a ray of light falls on a polished plane surface, the greater part of it is reflected in a definite direction. This is known as regular reflection. In Fig. 8 is shown such a condition. The angles which the incident and reflected rays make with the normal to the plane surface are called the angles of incidence and reflection, respectively. In the case of regular reflection, the angles of incidence and reflection are equal and lie in the same plane. This is the plane of incidence.

If the surface is rough, objects are no longer reflected from it, but light

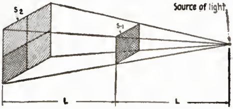


Fig. 6

The intensity of illumination on a unit of surface varies inversely as the square of the distance

rays go out from the surface itself in all directions as though it were a source of light. This is known as diffused reflection, and it is due to the breaking up and scattering of light waves by the roughness or irregularity of the reflecting surface.

The Velocity of Light

When a beam of light passes obliquely from one transparent medium to another, it is usually bent at the surface separating the two. This is known as refraction. Considering the passing of a light ray from air to water, as shown in Fig. 9, it has been found that the velocity of light in water is only three fourths as great as air. The velocity of light in all transparent liquids and solids is less than air, while the velocity in air is practically the same as in vacuum. When a light ray passes obliquely from a less highly to a more highly refractive medium, it is bent toward the normal; when it passes in the reverse direction, it is bent from the normal. The constant ratio of the sine of the angle of incidence to the sine of the angle of refraction is called the index of refraction of the two media. This ratio is con-

stant for the same two media for light of any given wave length, whatever may be the inclination of the incident beam, and the incident reflected and refracted rays are all in the same plane, called the plane of incidence, which is normal to the surface.

The luminous output of any light source can be measured in lumens. A lumen of light flux is the flux emitted in a unit solid angle by a point source of one candle-power. From the definitions of the lumen and of a unit solid angle, it is determined that a luminous

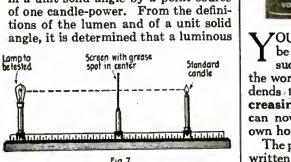


Fig. 7

A simple form of a photometer for comparing the light intensities

true point source of one candle intensity generates 12.57 lumens of light flux in the space all around it.

Illumination is the light flux density impinging on the surface of an illuminated object. Illumination is measured in a unit called the foot-candle, which is the illumination produced by a one candle-power source on a surface located just one foot distant from the point source. Light or luminous flux can be conceived as being comprised of many rays of light which emanate from the luminous unit to the eye. From this consideration, the greater the number of these rays that impinge on the object, the greater will be the illumination, and vice versa. The term illumination is applied only to designate the flux density incident on illuminated objects. Brightness measures the density of the light flux emitted from a surface either as a result of light emission or light diffusion.

C'assification of Lighting Systems

Foot-candle illumination varies directly as the luminous intensity in candles of a source, and inversely as the square of the distance between the point source and the point in space

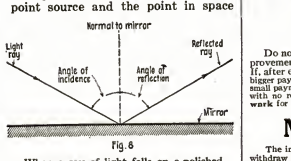


Fig. 8

When a ray of light falls on a polished plane surface a part of it is reflected

where the illumination is reckoned. Uniform illumination implies the lighting of an entire area with approximate uniformity. Streaks or shadows are undesirable because they are tiring to the eye. Localized or specific illumination is the illumination of a

certain relatively small area or some particular object.

All lighting systems can in general be classed under one of three classifications: namely, direct, indirect, and semi-indirect. In practically all lighting systems some portion of the illumination is received indirectly. In direct illumination, when efficiency is important the indirect portion should be made small, permitting only sufficient

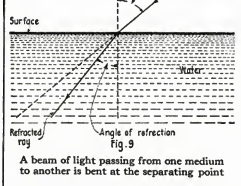


Fig. 9

A beam of light passing from one medium to another is bent at the separating point

light to reach the ceiling and walls to illuminate them to a low intensity, preventing a gloomy appearance. In indirect lighting the illumination is produced by the light rays being reflected from a large area—the upper portions of the room thus giving diffused brilliancy. In such a system there is no direct light received on the plane of utilization, the source of light being concealed in an opaque unit. Semi-indirect lighting is similar to indirect, except that the light source is mounted in a translucent rather than in an opaque unit.

The majority of interior lighting systems employ the incandescent lamps. These are in three general types: carbon, metalized, and tungsten filament. In incandescent lamps of older types the air was, in so far as it was practicable, exhausted from the space within the bulb and surrounding the filament, thus producing a vacuum. In most modern lamps, this space is filled with some inert transparent gas, such as nitrogen. The bulb must be transparent to permit the passage of light; not porous, so that it will retain the vacuum or inert gas; and strong enough to withstand handling and use.

The Arc Lamp

Street lighting and some store lighting employ the electric arc lamp. The principle of the arc lamp is briefly as follows: If two pieces of carbon are connected in series in an electric circuit and brought together, current flows through them. Because of the poor contact between the carbons, considerable heat is developed at the point of contact. If the carbons are slowly separated the resistance of the contact increases until the heat developed becomes sufficient to vaporize the end of one or both carbons. This vapor becomes a conducting path for the current after the carbons are separated, and the current flows through this vapor, forming an electric arc.

The stream of vapor between the two carbons offers a certain resistance to the flow of the current. With constant arc length the resistance of the arc varies inversely as the current flowing through it. This feature is of little consequence with series lamps, where the current is maintained constant by the generator or regulator; but with multiple arc lamps a ballast resistance must be provided to compensate for the instability of the arc.

Illumination design requires considerable skill and experience for successful solution. The general purpose of illumination is to render objects easily seen. As objects are seen by the light reflected from them into the eyes, much care is necessary in planning the number and intensity of the lighting units. The arrangement is also important.

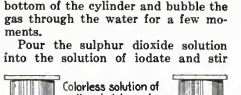
(To be continued)

It Takes Time to Make This Color Change

PREPARE a solution of sodium iodate by dissolving about one gram of the substance in a pint of water. Add to this a few drops of thin starch paste, made by boiling a pinch of starch with a little water, and stir the mixture thoroughly; then fill a cylinder or jar half full of the solution.

Prepare a dilute solution of sulphur dioxide by passing the gas from the generator, described in a recent number of POPULAR SCIENCE MONTHLY in the wine and water trick, into a cylinder half filled with water. Allow the delivery tube to extend nearly to the bottom of the cylinder and bubble the gas through the water for a few moments.

Pour the sulphur dioxide solution into the solution of iodate and stir



Two colorless solutions when joined will change in time to a deep purple

with a glass rod. Nothing seems to happen at first, but observe the mixture for five minutes. At some moment—depending upon the strength of the solution—a deep purple color will suddenly and instantaneously appear in every portion of the mixture.

The explanation is that the sulphur dioxide solution liberates free iodine from the sodium iodate, and this reacts with the starch paste to produce the purple color.—FLOYD L. DARROW.

Ink for Writing on the Smooth Surface of Glass

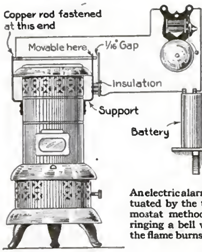
DISSOLVE 1 oz. of white shellac in 6 fluid oz. of menthylated spirit, and strain through muslin. Add slowly to this with agitation a solution of 2 oz. of borax in 12 oz. of water, mixing with the borax solution any water-color desired.

India ink may be substituted for the water-color with equally good results.—PAUL I. KENNEDY.

A Fire-Alarm to be Attached to an Oil Heater

EXPERIENCE with the very best kinds of oil heaters has convinced me that it is risky to leave them unwatched for any length of time. Probably there have never been so many used as during the last period of fuel shortage, and a great many fires were caused by them.

The oil heater illustrated can be used anywhere because of a fire-alarm which is easily attached to the stove.



An electric alarm actuated by the thermostat method for ringing a bell when the flame burns high

It is quite evident that a rod will expand and become longer when the temperature is raised. The stove is equipped with such a rod made of ¼-in. copper 12 in. long, and supported in a horizontal position over the top of the stove as shown. This rod is fastened at one end while the other is free to expand.

Just opposite the end which can expand is mounted a copper strip 4 in. high, insulated from the copper rod support. Between the movable end of the copper rod and the copper strip there is a gap of about 1/16 in. when the stove is at its normal heat.

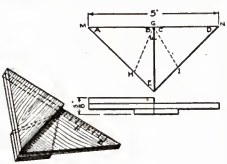
A bell located on the wall is connected with a battery and the copper rod. One connection goes from the copper strip to the battery; thus the connection is not complete until the copper rod expands and touches the copper strip, which will only happen when the stove overheats, begins to blaze up, and threatens to explode unless attended to.—F. E. BRIMMER.

A Tool of Many Angles for the Mechanic

SMALL in size and weighing little over 1 oz., but mighty in performance, is this little tool. It is a combined try, miter, octagon, hexagon, 22½ deg. and 30 deg. square. In addition, it is a ½-in. rule and can be used as a marking gage. It will be found extremely handy for small work.

The tool is made from three pieces of hard-wood 3/16 in. thick and glued together, with the grain crossed. The central main piece is 5 in. long at the base. The one shown on top of this is a half-section of the first, and the piece indicated by the dotted lines a quadrilateral the long edges of which, in combination with the sides of the main triangle, form the octagon and hexagon angles.

Most of the angles are produced by using one of the off-set shoulders against the edge of the work, as in using an ordinary try-square. The left-hand miter is made by putting the edge *A-E* coinciding with the edge of the work and using the edge *A-D* or base of the tool for the cut. The



The angles are produced by using one of the off-set shoulders against the edge of the work

left-hand hexagon is made by using the point *B* of the small triangle against the edge of the work in connection with the regular hexagonal line. The right-hand 22½ deg. is made by using the tool as for octagonal work, with a straight-edge against the main shoulder *B-E*. The left-hand 30 deg. is produced by using the tool in the same way, only with the hexagon shoulder against the work. The reverse of these two, finally, are best obtained by first marking the cuts just mentioned, drawing a vertical line *Y-Z* to intersect with the mark, and transferring the measurements *X-Y* and *Y-Z* to where the reverse cut is to be made, but placing the point *X* to the right of *Y*. A line through *X-Z* will mark the reverse angle.

Two inches should be marked off on the edge *C-D* and its opposite edge *G-N*, the marks running entirely round the edge. They are best made with a very sharp and very hard pencil. A coat of shellac or varnish will mark these graduations indelibly on the wood.

A Holder and Container to Protect a Dictionary

AN unabridged dictionary, an encyclopedia, or other large and cumbersome book, frequently has a short life in a school, library, or office where it is constantly used for reference purposes. Such books are so large and heavy that the bindings often are of insufficient strength to withstand the severe usage to which books of reference are subjected.

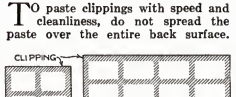
The bottom has a sloping bottom to hold the book without breaking the back

The accompanying illustration shows an economical support and container for a dictionary that ordinarily will triple the life of the volume. It consists essentially of a shallow box with a hinged cover that is made with correct dimensions to contain the book in an opened condition. As indicated by dotted lines, inclined strips of wood support the covers of the dictionary so that it will not open far enough to strain the binding. As the book is never closed and never moved, except in its container, it is subjected to minimum wear.

The cover protects the volume from dust, dirt, and breezes, when not in use. Pieces of felt glued to the bottom of the box prevent the marring of the polished surfaces on which it rests.—C. J. BRICKETT.

A Rapid and Cleanly Method of Pasting Clippings

TO paste clippings with speed and cleanliness, do not spread the paste over the entire back surface.



Manner of applying the paste in strips to hold the clippings smoothly

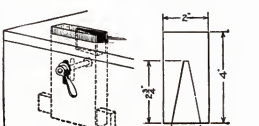
Run it in broad lines along the edges and across the center, as shown in Fig. 1. For larger clippings add more lines of paste; crossing the lines holds the clippings flat by equalizing the stretch, and this overcomes the tendency to wrinkle.—JAMES M. KANE.

A Disappearing and Adjustable Bench-Stop

THE ordinary bench-stop is very much in the way most of the time, and rarely of just the proper height for the work at hand. It ought to be ⅛ in. high for one job, and 1½ in. for the next. Very frequently it ought to be conspicuous by its complete absence.

In the illustration is shown a bench-stop which fulfils all these requirements and which is easy and inexpensive to make. The only materials necessary are a good block of wood, 2 in. thick by 4 in. wide, and about 1 ft. long, a ⅜-in. bolt 3½ in. long, a ⅜-in. washer, and a ⅜-in. tail-nut.

A hole for the bolt is bored centrally through the side of the block, and the dimensions of the stop-opening laid out on one end. This opening is then carefully worked out with saw and chisel. The exact size of this end is next marked on the bench-top so as to bring the block, when in place, flat against the inner face of the side-board, with no play anywhere. This opening is now cut so that it will just allow an easy sliding fit for the block, and no more.



The stop slides in a mortise cut in the bench top and is held with a bolt

The block is placed in position with the surface of its working end flush with the bench-top and the bolt struck a sharp blow, marking its location on the side-board. A 7/16-in. hole is bored through this mark and a vertical slot of the same size cut upwards a distance of 1½ in. The bolt is then driven into place in the block and the washer and tail-nut put on. Any portion of the threads protruding beyond the nut when it is tightened is cut off with a hack-saw.

To guide the block at the lower end, small blocks are nailed to the side-board close to each edge of the block.

A "twist of the wrist" is all that is needed to place this bench-stop at any desired height adjustment, or to cause it to disappear completely. Incidentally it has the advantage that the opening, being worked out of the end-grain of a stout timber, has several times the strength of a stop cut out of a board-end, and that absolutely no nails, screws, or other iron parts can ever be uncovered to ruin a plane, there being no such parts to uncover.—HENRY SIMON.

Warring for Peace

TWO MILLION American Soldiers in France! Two million men from 3,000 to 6,000 miles from home—brought to American sailing ports by American steam and American electric railroads. Then carried across 3,000 miles of ocean by great steam liners.

Transportation *never* was so important as it is right now. It is so big that it's Government work. Just think! hundreds of thousands of miles of tracks, thousands of locomotives, more thousands of coaches, freight, baggage and mail cars and an army of trained railroad men helping Uncle Sam to war for peace.

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Ives Electric Trains are the kind you've always wanted—big, speedy, powerful—just like real trains. They spin along on a straight track, whirl around curves, whizz through tunnels, pass over switches, slow down at warning signals, stop at stations and start again as you want the trains to do.

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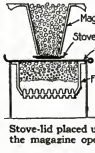
Rebuilding a Hard-Coal Fire to Keep It Burning

LARGE hard-coal heaters of the magazine type have, at times, a disagreeable habit of going out in the night, no matter how carefully the fire may have been attended to in the evening. This, of course, is frequently due to the choking of the coal at the neck or bottom of the magazine funnel.



Stove-lid placed under the magazine opening

When the fire dies out, in most cases of this kind, a full magazine of coal is left above, which must be removed and the fire-pot cleaned of ashes and clinkers preparatory to making a starting fire of soft coal or coke. Getting the unburned coal out of the magazine is the largest part of the undertaking.

The illustration herewith will explain how this disagreeable feature can be prevented and a new fire huilt. Before the fire-pot is cleaned, a lid from the kitchen range is pushed under the mouth of the magazine and supported hy a poker laid across the fire-pot. If the poker is a little long, it can stick into the damper-chamber for a distance, so that the handle end will rest on the edge of the pot near one of the front doors. If the lid does not fit closely against the magazine it does not matter, for if the coal is a little coarse it will choke and its weight will hear squarely over the surface of the lid, so that it will not have the least tendency to tip, even if supported only by the narrow poker. The fire-pot can then he thoroughly cleaned and the new fire huilt without the necessity of taking out the good coal remaining in the magazine above.

When a sufficiently hot bed of coals has accumulated, the lid can be readily withdrawn with the ordinary lifter, at the poker hy means of the ring in its handle.—FRANK W. BENTLY.

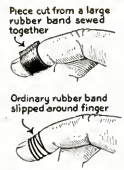
Lifting Power of Small Pilot Balloons

BALLOONS are being used extensively by the belligerents in the great war as observation towers to direct the artillery fire. They are capable of sustaining very heavy weights. Here is a table giving the diameter, capacity in cubic feet, and lifting power of such balloons.

Diameter	Capacity	Lifting Power
5 ft.	65	4 lb.
6	113	7
7	179	11
8	268	17
9	381	24
10	523	33
11	697	44
12	905	57

Rubber Bands Used on Finger for Turning Over Leaves

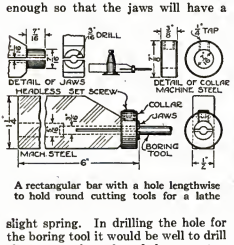
IN turning over a bundle of papers, running through a pile of canceled checks and duties of a like nature, it



is customary to keep moistening the fingers by means of a sponge in order to facilitate the work. This sponge can be done away with completely if a rubber band is slipped loosely around the finger, as shown, or a more comfortable and permanent arrangement can be made by cutting a piece from a wide rubber band and sewing it together at the ends. This method is largely used in express and railroad offices and is well worth trying, even though the rubber-banded finger may be used only part of the time.—GEORGE M. PETERSEN.

A Lathe Boring Tool for Holding Round Shank Cutters

THE illustration shows a type of tool holder which has been found very successful in ammunition work. This holder could be used with equal success on any other work where the hole to be bored is of small diameter. The bar may be of any size, in this case the dimensions were as indicated. The slot should be milled back far enough so that the jaws will have a

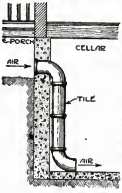


A rectangular bar with a hole lengthwise to hold round cutting tools for a lathe

slight spring. In drilling the hole for the boring tool it would be well to drill all the way through and then counterbore as shown. This will permit the operator to use long pieces of drill rod and it also serves as a "knockout" hole when the tool sticks. The collar is a solid ring and the ½-in. set screw may be of the ordinary or of the headless type.—FRANK W. HARTH.

For the Thorough Ventilation of a Cellar

A WELL drained and frost-proof cellar is not always the ideal place to store farm produce and anything of a perishable nature, unless it is airy and very well ventilated. In the sultry days of spring it is sure to be damp. The usual remedy is to open the windows at night and let the cool air in. This helps some, but the moisture settles to the bottom of the room, causing potatoes to sprout and other vegetables to become moldy. Thousands of well built cellars and root-houses have this defect.

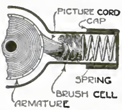


Sectional view of the pipe for ventilating the cellar

A simple way to overcome the fault, and to have a dry and airy cellar, is to conduct the air from the outside to the floor of the cellar. This can be done by means of wooden chutes; but the best way is to use glazed tile—sewer-pipe—the kind having hubs or rims. The outside opening should be under the porch, if possible, as the air is cooler there and the openings are not apt to be stopped with leaves and snow. A damper can be placed in the pipe to regulate the air; but this is not necessary, as there are only a few days in winter when the air will have to be shut off, and this can easily be done by placing a bag in the lower elbow. The opening outside should have a piece of copper fly-screen placed in the elbow, which is held in place with a little cement.—EDWIN HILD.

Twisted Picture-Cord Used for a Fan Motor Brush

ON a fan motor one brush had become so worn that the motor would not operate. In order to repair this a brush was made of a piece of picture cord. The spiral spring holding the brush against the commutator on the armature was removed and the cell thoroughly cleaned with gasoline. A short length of common picture cord was cut and doubled twice and twisted; then one end was cut evenly with clippers so that a brush was formed of the fibers in the wire. The wire was then inserted in the cell and held against the commutator with the spring and cap. When the current was applied the motor worked as well as when it was entirely new.—L. B. ROBBINS.



Brush compartment of fan motor filled with picture cord

Woolen Hose May Be Converted into Warm Army Mittens

During last Winter the shortage of mittens in an army camp left some of the boys without anything to keep the hands warm. There was an over supply of wool hose. One private

A wool hose will make a warm mitt, if you have more hose than mitts

in the camp devised a means of converting the extra hose into mittens for the needy ones. The upper end of each hose was sewn up and folded inside to make a double thickness. These mittens without thumbs can be worn while doing several different kinds of work.—Dudley Hess.

Converting an Old Lawn-Mower into a Post-Hole Auger

The illustration shows a very simple way of making an auger for digging post-holes from the cutter reel of a lawn-mower. The axle which was 5/8 in. in diameter, in this case, was removed from the blades by releasing the set screws; then the ends of the four blades were heated sufficiently to permit their being cut about 1 in. inside of one of the castings, and then bent into the shape shown. The blades were then sharpened to a thin angle on an emery wheel. A piece of 3/8-in. gas-pipe 3 feet 8 in. long, with a 12-in. T-handle attached to one end, was fitted into the castings that had held the axle, and tightened with the set screws.

The blades of a lawn-mower used as a post-hole auger

The gas-pipe was 1/16 in. greater in size than the discarded axle, and it was necessary to remove this surplus on an emery wheel before it could be fitted into the castings. The castings that hold the blades are skeleton affairs and do not hamper the feed of the auger; they also serve in holding the dirt when lifting it from the hole.—R. J. Stephens.

How to Make a Wheeled Serving-Tray

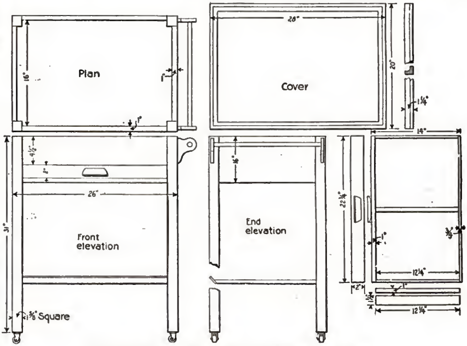
A SERVING-TRAY like the one here illustrated conserves both the time and energy of the housewife. Such a home convenience saves many trips between the dining-room and kitchen, especially in a roomy farm-house, where very many dishes are handled. The top and shelf spaces of the tray are large enough to permit of removing all the dishes from the table in one trip. It is also a time-saver when serving refreshments on social occasions. Likewise, it can be converted into valuable use as a bed-side stand in the sick-room; or, when attractively designed, it will serve the purpose of a reading or flower stand.

The serving tray closed presents a neat stand used for other purposes

When the tray is opened it shows space for a complete set of dishes

The upper section of the tray is box-shaped, 16 in. wide and 26 in. long, inside measurement. This is supported by four legs each 1⅝ in. square and 31 in. long. The top of the tray, or the cover of the china compartment, is edged by 1¼ in. molding. This compartment is 4½ in. deep, and is painted white within.

The sides of the compartment are provided with screw-hooks on which cups may be hung. There is space in the compartment for serving dishes for six persons. Below the serving compartment is a drawer 2 in. deep, divided into two parts. One side is used for linen and the other side for silver. The side adapted to silver is lined with a dark-colored felt or outing flannel.

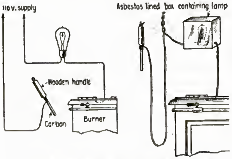


Details showing how to construct the serving tray. It can be made in any wood suitable to match other furniture

In the space below the drawer a large under shelf is placed. The serving-tray rests on noiseless swivel casters, which permit it to be turned completely around. Small wheels used on baby carriages can be substituted for the casters.—S. R. WINTERS.

Lighting the Gas Stove with an Electric Spark

THE gas range may be lighted electrically without the use of a spark coil by using the lighting current connected with a lamp in series with the line. The connections are shown in the diagram.



Wiring diagram and device for making an electric spark to light the gas

A carbon rod in the circuit is provided with a wooden handle which has a screw-eye in the top to hang it up near the gas range. To obviate the annoying flicker, the light is mounted in a small wooden box lined with asbestos. When it is desired to light the gas, the carbon rod is touched to the burner and produces a spark which ignites the gas.—RAYMOND FRANCIS YATES.

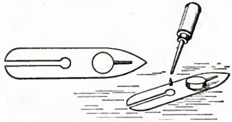
Rollers Help to Carry Heavy Tool-Boxes

ONE type of tool-box though somewhat smaller than a trunk is larger than the average suit-case—too cumbersome for workmen to carry to their work. In one case, a mechanic procured a pair of ordinary furniture rollers of large diameter, and fastened them to the two lower corners of one end of the box. By means of a handle at the other end he was able to pull it for long distances. When the box was placed flat the rollers were raised from the floor.—FRANK L. MATTER.

Casters on the end of a heavy tool box help to make the load much lighter

A Drop of Oil Makes This Toy Paper Boat Run

Outline on a piece of heavy bond paper, 3¼ in. long, the shape of a ship as shown in the illustration, and in its center cut a round hole with a channel to the stern end. Ordinary oil



The oil spreading on the surface of water makes the propelling power

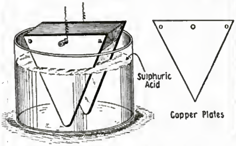
is used for the propelling power. Sewing machine oil will do very well. Place the boat at the end of a sink full of water so that its under surface is quite well dampened, leaving the upper dry. Place a drop of oil in the round hole from the can. The boat will move at once and cross the sink.

The reason for this movement is very simple. The oil, as soon as it touches the water, tries to spread and the only direction in which it can move is out through the channel to the rear. The result is that the oil sets up a reaction which drives the boat forward.

Home-Made Rheostat for Service Lines or Batteries

A very efficient rheostat for use either with batteries or on a house lighting circuit can be quickly and easily made in the following manner:

Cut two pieces of heavy sheet copper in the triangular shape shown in the diagram, making the dimensions such that when placed in a large tumbler or small battery jar the dotted line will come to the top edge. Drill holes in



Copper plates fastened to a block and set in an acid solution to make a rheostat

each for two tacks and a binding post. Now cut from a ½-in. board a piece long and wide enough to fit the copper sheets and tumbler. Tack the copper sheets to this and screw in the binding posts.

When placed in the tumbler containing a solution of sulphuric acid it forms a very practical rheostat. The amount of resistance may be varied both by changing the height of the sulphuric acid in the tumbler and by varying its strength. The smaller the surface of copper immersed in the liquid and the weaker the acid solution, the greater the resistance.

Statement of the Ownership, Management, Circulation, etc., required by the Act of Congress of August 24, 1912, of Popular Science Monthly published monthly at New York, N. Y., for October 1, 1918. State of New York, County of New York, ss. Before me, a notary public, in and for the State and county aforesaid, personally appeared O. B. Capen, who, having been duly sworn according to law, deposes and says that he is the Business Manager of the Popular Science Monthly and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor and business managers are: Publisher, The Modern Publishing Company, Inc., 225 West Thirty-ninth Street, New York, N. Y. Editor, Waldemar Kaempffert, 225 West Thirty-ninth Street, New York, N. Y. Managing Editor, Waldemar Kaempffert, 225 West Thirty-ninth Street, New York, N. Y. Business Manager, O. B. Capen, 225 West Thirty-ninth Street, New York, N. Y. 2.—That the owners are: The Popular Science Publishing Company, Inc., 225 West Thirty-ninth Street New York, N. Y. Stockholders of Popular Science Publishing Company, Inc., Henry J. Fisher, 22 William Street, New York, N. Y.; Oliver B. Capen, 225 West Thirty-ninth Street, New York, N. Y.; Robert Cade Wilson, 683 Springfield Avenue, Summit, N. J.; Waldemar Kaempffert, 225 West Thirty-ninth Street, New York, N. Y.; George B. Agnew, 22 William Street, New York, N. Y.; Susan D. Bliss, 22 William Street, New York, N. Y. 3.—That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent. or more of total amount of bonds, mortgages, or other securities are: Importers and Traders National Bank, 247 Broadway, New York, N. Y.; H. J. Fisher, 22 William Street, New York, N. Y.; Geo. H. Mead Company, Dayton, Ohio. 4.—That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

(Signed) O. B. Capen, *Business Manager.*

Sworn to and subscribed before me this 24th day of September, 1918.

Robert A. Macbeth, certificate filed in New York County. (Seal). My commission expires March 30, 1919.

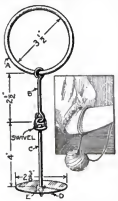
Therefore to diminish the resistance and increase the current add more of the acid solution so that it will rise higher on the copper plates or strengthen the solution by adding a little more of the concentrated acid. The closer the plates are together, too, the less the resistance.

The resulting chemical action will gradually use up one of the plates and change the sulphuric acid into copper sulphate, but these may be easily renewed.—FLOYD L. DARROW.

If You Knit for Soldiers You'll Need This

AS long as the war continues we can be certain that the knitting fad will continue to hold the interest of women.

All of these patriotic knitters know that a ball of wool will not unwind uniformly as needed and "stay put" unless held in position by some device such as the one illustrated here.



Yarn ball holder to slip on the arm

The ball holder can be made of almost any material such as celluloid, brass, tin, etc. The ring *A* should be continuous and smooth so that the link *B* will slide readily. The link *B* in this case is made in one piece of a single length of brass wire. It may be made of a chain of equal length. Pivot *C* is provided with a swivel at one end and three or four threads on the other. A nut *E* is fastened to disk *D*——with solder if the disk is brass or tin. On the other hand, if the disk is made of celluloid, the nut can be fastened by the usual method. The object of the nut is to provide a thread for the disk so that it can be screwed onto the pivot. The disk, if made of brass, can be stamped with designs, making the device not only useful but ornamental.

The wool is wound in a ball in the usual way. The pivot is then pushed into the ball slowly, working it slightly from side to side, the idea being to avoid splitting the individual strands of wool, as this would prevent the wool from unwinding when that particular spot was reached, and then necessitating unscrewing the disk and removing the pivot. Or, if desired, the wool may be wound directly upon the pivot—thus preventing any possibility of the yard being split. The disk is then screwed into place and the ball is ready for work. Illustration shows the holder in use. The ball hanging freely will revolve at the slightest pull and will not interfere with the knitting process.—FRANK W. HARTH.

Twenty-five Dollars for You

Tell us the best way of using an old automobile tire and win the first prize in the Popular Science Monthly Contest

WHAT do you do with your old automobile tires? Throw them away? Sell them to the junk-dealer?

We have seen old tires used as life-preservers. There must be other even more practical uses for them. We wonder what the ingenious mechanics and farmers throughout the country have done with their old tires—to what practical uses they have put them in the home and in the shop. Let them step forward and tell us. The POPULAR SCIENCE MONTHLY offers three prizes—a first prize of $25, a second prize of $15, and a third prize of $10—to be awarded in accordance with the rules published below:

Rules Governing the Contest

(1) Contestants are not limited to the number of methods of utilizing old tires which they may describe. But only one method can possibly win the first prize, only one the second, and only one the third. The contest is open to everybody.

(2) The method of using old tires must be clearly shown either in a photograph or in a drawing. If a drawing is sent in, it need not be made by a skilled draftsman. It is sufficient that it should be intelligible. While pencil sketches will be considered, contestants are requested to make their drawings in ink on bristol-board. The views should be sufficient in number to set forth the use of the tire very clearly. The contestant's name and address should appear on each sheet of drawings.

(3) The drawings or photographs must be accompanied by a description, preferably typewritten, in which the method of utilizing the old tire is clearly given. It must be written on one side of the paper only, and it should not be more than 500 words in length. The name and address of the contestant should appear in the upper left-hand corner of the first sheet of the written description.

(4) The drawings and description entered by contestants must be received by the POPULAR SCIENCE MONTHLY not later than 5 P. M. on December 31, 1918.

(5) The judges of the contest will be the editors of the POPULAR SCIENCE MONTHLY.

(6) The first prize of $25 will be awarded to the contestant who, in the opinion of the judges, has suggested the simplest and best method of utilizing an old tire.

The second prize of $15 will be paid to the contestant who submits a method next in merit.

The third prize of $10 will be paid to the contestant who submits the method third in merit.

(7) The winners of the contest will be announced in the earliest possible issue of POPULAR SCIENCE MONTHLY. A description of the methods which won these three prizes offered will duly appear in the pages of the POPULAR SCIENCE MONTHLY, together with the names of the winners.

(8) The editors of the POPULAR SCIENCE MONTHLY shall have the right to publish meritorious methods of utilizing old tires which do not win a prize. The regular space rates will be paid to the contestants who submit manuscripts on the methods thus selected.

(9) When a contestant submits more than one method, the description and drawing by which it is set forth must be sent as a separate unit.

(10) No manuscripts or drawings will be returned to contestants unless postage is enclosed.

(11) Send drawings and specifications to the Tire Contest Editor, POPULAR SCIENCE MONTHLY, 225 West 39th Street, New York City.

A Square Bucket for Handling Sand for Street Cars

AT the terminals of street-car lines a large sand-box is usually provided, so that motormen can fill up the sand-boxes on their cars to be used for sanding the rails. In carrying the dry sand from the supply box to the cars in an ordinary round bucket much of the sand is spilled out while being poured into the container. To overcome this a tapered square bucket, like the one shown in the illustration, has been found to be a good method of handling the sand without spilling it.—R. O. HELLWIG.

A square bucket does not spill the sand

A Home-Made Turning Tower for the Children

THIS holiday decoration is known as a Christmas pyramid. It is made of wood, with a revolving tower set in the interior of the upper part. This tower has shelves on which small soldiers, candles, and other ornaments

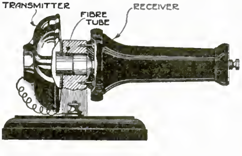
A novelty turning tower driven by the heat from the candles and fan at top

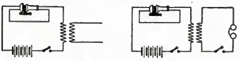
are placed, to be displayed as the shelves follow the circle. By means of rods hidden behind the shelf drapery, bells play a tune as the shelves move around.

The lower foundation is permanent and can serve as a doll-house. To cause the tower to revolve and play its tune, the candles are lighted. The heat from the candles causes the fly-wheel on the extreme top to go around, and in its rotation it carries the tower with it.—CLARENCE T. HUBBARD.

An Audio Frequency Oscillator of Simple Construction

THE constant demand for a source of current having a constant amplitude and frequency for laboratory measurements has been met in the past by utilizing a buzzer or some similar device to interrupt the circuit. An instrument which does not break the circuit entirely, but acts to vary the strength of the current, would obviously be superior to any buzzer arrangement. The latter mode of operation is the underlying principle of the audio frequency oscillator shown in the accompanying illustration.





The tone is due to the reaction on each other of the two pieces producing rapid variations

The phenomena that take place when the receiver of a telephone is placed over the transmitter mouthpiece are familiar to many readers. The tone emitted is due to the reaction on each other of two pieces of apparatus, producing extremely rapid variations of the current strength in the circuit. The note is clear and, when the two are rigidly fixed with relation to each other, is of a constant pitch. The frequency is dependent on several factors, chiefly the material and sizes of the diaphragms in the two instruments and the volume and length of the air column through which they act.

The pitch of the note can be varied easily by arranging some means for changing the length of the air column between the instruments, as can be proved by placing a receiver over the mouthpiece of a transmitter and then gradually separating them. However, for laboratory work a fixed note will answer all requirements.

A transmitter of the metal diaphragm type, a receiver of 80 ohms resistance, and some means of mounting them in close relation to each other are necessary for the construction of the audio frequency oscillator. For the base of this instrument a 5-in. fixture block was utilized. The upright block was cut from 7/8-in. pine and measures 3 1/4 in. by 1 3/4 in. A hole was then drilled in the block 7/8-in. from the top. The size of this hole will depend upon the style of transmitter you intend to use. Should it have a male thread to take the mouthpiece, the hole should be of such a size as to take the thread with a tight fit so it can be screwed into place. With a female thread on the transmitter it is necessary to bore a hole the same size as that in the transmitter and fit a short brass or, preferably, fiber tube in the hole, allowing it to extend sufficiently so the transmitter can be screwed over the hole.

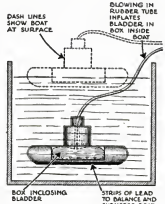
To mount the receiver, drill two holes in the cap at opposite sides of the hole and countersink them on the inside. With two small flat-head screws the cap can then be fastened in place with the hole central to that in the block of wood. These screws should come well below the surface of the hard rubber or they will touch the diaphragm of the receiver and interfere with its proper action. The receiver body is then screwed into place. The instrument can be finished in any manner desired and binding posts arranged to make connections.

To test the device, connect the receiver and transmitter in series with five or six dry cells. The instrument should emit a clear note as soon as the circuit is closed. If it fails to do so, reverse the connections to the receiver.

To use the device for measuring purposes it is often impractical to connect the other apparatus in series, so it is necessary to utilize a telephone induction coil in connection with the oscillator.

It makes little difference which winding, primary or secondary, is connected in the circuit with the instrument.—T. W. BENSON.

Toy Submarine Controlled by Air



The boat is controlled by air pressure through a rubber tube

IT is not at all difficult to build a boat that will submerge and rise at will without, apparently, being directly controlled. The materials necessary are a small box about the size of a cigar box, a rubber bladder, 2 ft. of rubber hose and some pine lumber.

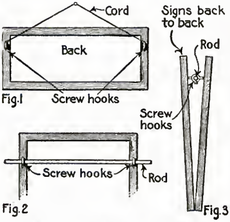
The boat may be built any shape and manner desired so long as the box is placed in the center. A boat with a hollow body would be all right without the box. Inside the box, or the cavity of the boat, put a football bladder on the end of which a rubber hose 2 ft. long has been cemented. On top of the body of the boat a

cylindrical tin can is placed, and on top of this can another smaller one. These are not essential parts of the submarine and may be left off, or the boat made in a different manner. The hose extends up through these cans and over the side of the vessel which holds the water in which the boat floats.

Strips of lead, or some other metal, should be nailed along the bottom of the boat in order to balance it and make it just heavy enough to slowly sink when no air is in the bladder. Holes cut in the sides of the box and cans help it to sink by filling with water. To cause the boat to rise, inflate the bladder with the mouth, through the rubber hose, compressing it until there is enough to float the submarine. Allow the air to escape and the boat sinks. If desired some means of propelling the submarine may be added to the boat, such as a propeller run by a clock spring.—F. E. BRIMMER.

Frame Hooks for Handling a Newly Painted Sign

HANDLING a freshly painted sign usually means a broken frame. A very convenient and safe method,



Frame hooks to keep apart the freshly painted sides for carrying the signs

as well as one that economizes space, is to attach several screw hooks to the back of the frame, as shown in Fig. 1. The sign can then be moved as often as desired, without smudging. If the sign is large a piece of rope can be fastened to the screws and the sign hung up like a picture.—J. M. KANE.

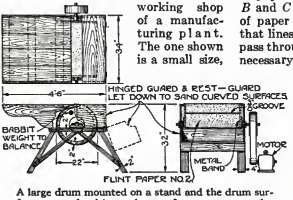
Splitting Paper to Keep Articles on Both Sides

IT often happens, in making a scrapbook or cutting out advertisements for filing, that there is something important on both sides of a page. The remedy is to split the paper.

To do this, paste the desired clipping between two heavy sheets of paper, and, when thoroughly dry, quickly and without hesitation pull the two pieces apart. The paper will split in half, leaving each half stuck to its heavy sheet of paper. These are easily removed by soaking in water, and, except for a little dullness in the ink and thinness of the paper, are as good as ever.—VICTOR H. TODD.

An Inexpensive and Practical Sanding-Machine

THE illustration shows a very clever design for a home-made sander which can be used in the home workshop or, if built on larger dimensions, for the pattern or woodworking shop of a manufacturing plant. The one shown is a small size, its drum being made up by spiking staves 30 in. long, 3 in. wide and 2 in. thick to circular end pieces. These pieces were cut to 18 in. in diameter, making the outside diameter of the drum 22 in. The drum may be driven by an independent motor or with a belt from a line shaft at a speed of 300 r. p. m.



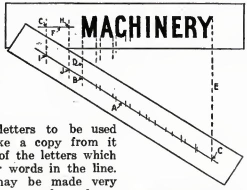
A large drum mounted on a stand and the drum surface covered with sandpaper for a power sander

After mounting the drum and applying the power it was turned down perfectly round and smooth, and then balanced by attaching a piece of babbitt metal on the inside where it seemed light. A pad of cotton flannel was put around the drum on which a piece of No. 2 sandpaper was glued, the ends being fastened with a stick driven into a ⅜-in. groove cut in the surface of one of the staves.

Knotty and cross-grained pieces of wood may be given a surface by running them back and forth on the drum as it is turning. This surface cannot be obtained in any other way.—L. F. ASHLEY.

Laying Out Letters to Fill a Given Space

THE method sometimes employed for dividing a line into a given number of parts may be used for locating the boundary lines for letters so that a line of letters will exactly fill a line of given length. If a printed alphabet of the style of letters to be used is at hand, make a copy from it on tracing-paper of the letters which form the word or words in the line.



Method of laying out letters for enlargement

This tracing may be made very rapidly, and having traced one letter it is comparatively easy to space the succeeding letters correctly, because of the transparency of the paper. If one is fairly expert in spacing letters, it will only be necessary to indicate on the tracing-paper the vertical boundary lines of the letters.

Suppose the line of letters of the copy is 10 in. long and we wish to fill a line 18 in. long. Tack the copy to the drawing-table in a horizontal position. Draw a line *A* on a strip of paper and on the line mark points *B* and *C* 18 in. apart. Tack the strip of paper to the board in such a way that lines *D* and *E*, if extended, would pass through points *B* and *C*. It is not necessary to draw lines *D* and *E*, because the points *B* and *C* can be placed in the right position with the aid of the T-square. Place the T-square on the lines marking the vertical boundaries of the letters and mark the points on line *A* where the lines would fall if they were extended.

To determine the height of the letters, draw a horizontal line *F* on the tracing-paper and on it mark points *G* and *H* to indicate the height of the letters of the copy. On the line *A* mark the points *I* and *J* where the lines extended from *GH* would fall. The strip of paper is now removed from the table, cut along line *A* and the points transferred to a line drawn on the drawing-paper to receive the final lettering.

If a printed alphabet is not obtainable the words in the lines may be drawn to the approximate size and this method used for correction to exact size.—C. H. PATTERSON.

An Effective Way of Handling Manure on the Farm

THE farmer should appreciate more fully the value of manure and the proper methods of handling it. He should figure it as worth at least $2 a ton, and he should get that amount, or in many cases much more, out of it by proper handling.

Just how it ought to be handled depends upon conditions. The best method, where cattle are fed in barns, sheds, or lots, is to haul the manure to the fields day by day or week by week as it accumulates. There is the least loss in handling it in this way, although the plan is not always feasible.

The next best plan is to feed under an open shed, where the manure may accumulate and where it will be kept tramped down compactly by the animals. Under such a plan it will be kept sufficiently compact and moist to prevent rapid fermentation, and, next to hauling to the fields day by day,

this provides for the least loss of fertilizing constituents.

One of the cheapest plans is to feed directly back on the fields; but, in this case, the feeding is often done on some hillside, where washing and leaching carries away the larger part of the fertilizing constituents; or else the cattle are fed in some sheltered wood lot where the manure is lost to the fields.

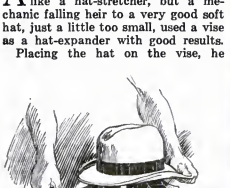
In this connection it should be said that on a farm of 100 acres or over a manure-spreader will pay; and where much stock is kept it will pay handsome returns on farms of much smaller size. It is generally considered that the value of a manure-spreader lies in the saving of labor; but, while this is an important reason for its use, it is not the only one. A reason that is as important, or even more so, is the fact that manure put on evenly and rather lightly over a large area will give larger returns to the ton of manure applied than the same manure put on heavily and irregularly over a small area. This difference in return will frequently pay for the spreader in a single season.

There is one other reason why a farmer should own a spreader, and that is, when he has his money invested in such an implement, he will invariably take much better care of the manure that his farm produces.—F. H. SWEET.

Using a Vise for Stretching a Soft Hat

A MACHINIST'S vise does not look like a hat-stretcher, but a mechanic falling heir to a very good soft hat, just a little too small, used a vise as a hat-expander with good results.

Placing the hat on the vise, he



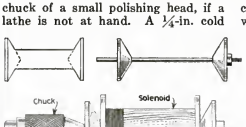
Pressure applied to a hat on a vise to increase the size

opened the vise, then closed it, moved the hat around a trifle, and opened it again. By repeating the operation until he had turned the hat around the entire circumference, a uniform expansion resulted without deforming the hat. A little gasoline cleaned the grease from the vise before using it as an expander.

It is needless to say that this method of stretching would be fatal to a stiff hat.—JAMES M. KANE.

Tool for Winding Solenoids Made of a Thread Spool

BY means of the little tool shown in the illustration, solenoids may be wound with little trouble in the chuck of a small polishing head, if a lathe is not at hand. A ¼-in. cold



The ends of a common thread spool mounted on a rod for winding coils

rolled steel rod is threaded at one end and provided with a nut. Both ends are then cut from a large wooden thread spool as shown in the illustration.

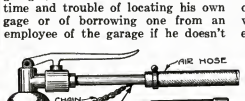
One end is permanently fastened to the end of the rod by drilling a hole through the wood and the rod and driving a pin into the hole. The tool can then be put into the chuck and the solenoid placed on it. As the wooden ends are tapered, solenoids with different sized centers can be wound very easily.—RAYMOND FRANCIS YATES.

Ink that Will Flow Evenly on Celluloid Surfaces

TEN parts of ferric chloride and a hundred parts of acetone, and fifteen parts of tannin mixed. This solution may be used with any kind of a pen. Users of fountain-pens will do well to give this a trial.

Attaching Pressure Gage to Air Hose for Convenience

FOR the convenience of customers a tire-pressure gage may be attached to the end of the air hose in garages, which saves the customer the time and trouble of locating his own gage or of borrowing one from an employee of the garage if he doesn't



A pressure-gage chained to the air-hose connection for an automobile air-tank

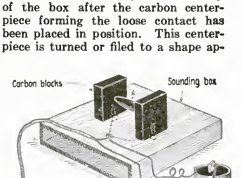
own one. One end of a piece of light chain about 12 in. long is soldered to the gage and the other end is similarly attached to the hose nozzle as shown in the illustration. This method of attachment places the gage at the service of customers without trouble to garage attendants and also eliminates all danger of its being carried away accidentally.—H. W. OFFINS.

A Super-Sensitive Microphone for the Laboratory

THE microphone depends upon the fact that the electrical resistance of a loose contact between two conductors changes under the action of sound waves. Variations of the current can thus be produced in a circuit, these variations corresponding to the sound waves which produce them. This is the principle of the instrument in the accompanying illustration.

The transmitter consists of a sounding box and three carbon conductors.

The top of the sounding box is constructed first. It is made of best white pine 3/16 in. thick, and so is the rest of the box. The carbon conductors fashioned in the shape of rectangular prisms are fastened securely to the top of the box after the carbon centerpiece forming the loose contact has been placed in position. This centerpiece is turned or filed to a shape ap-



Variations of the current can be produced in a circuit corresponding to the sound-waves

proximating that of a cigar, and of a previously calculated dimension in order to permit it to rest lightly in two small conical holes drilled in the carbon uprights without forming a tight joint. This precaution is of utmost importance, since it is this piece of carbon that vibrates in accordance with the sound waves set up from the external source in the region of the instrument.

Insulated wire is then run through a small hole in the top of the box from the terminals beneath the carbon uprights, and the sounding box is completed. Its outside dimensions are 6 in. long, 4 in. wide and 1 in. thick. All the joints should be tight and well-fitted, and the exposed surface of the box covered with a thin varnish or shellac to obtain the best results. The instrument is connected with a battery and telephone receiver, and it is then ready for use.

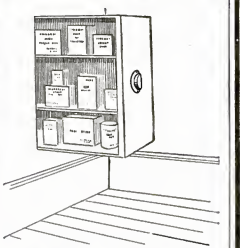
It is extremely sensitive so that the receiver may be used at a considerable distance from the source of sound, and it always gives very satisfactory results.—HERMAN NEUHAUS.

A Built-In Upright Drawer Used in Place of Shelves

THE small boxes and packages used in every kitchen are about the worst dust-catchers possible if openly displayed on shelves. If they are kept in a cupboard, they are not handy and even there they collect considerable dust. Small cupboards built for the purpose, again, have the disadvantage that doors must be continually opened and closed to their full width, and are more or less in the way when they are opened.

These disadvantages are all overcome in the arrangement here shown, and which might be termed a cupboard in the shape of an upright drawer. Pepper, salt, and all spices, baking-powder, soda, and other small articles put up in bottles, cans, and boxes, are here assembled and always within easy reach of the housewife, though they are normally not only out of the way, but entirely out of sight.

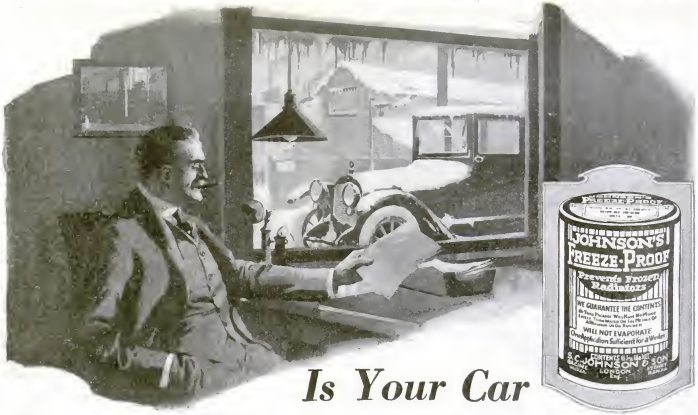
In this particular instance, the drawer is built into an air-cooler just



The drawer in an upright position as it is drawn from the wall

at one end of the sink-board and above the place where the bread-board is kept and used. A simple pull, and all are at the instant disposal of the cook. A light push, and they have disappeared. Dust has no chance at all to collect on articles kept in such an upright drawer, and the cleaning needed to keep them, and the shelves on which they stand, in spotless condition, is less than one twentieth of the work needed to clean them if they were kept on open shelves. On the other hand, a well-made drawer is always more easily and conveniently opened and closed than the smallest door. An added feature is that the half-dozen most needed articles, can be placed right near the front end of the drawer, so that it is only necessary to open it a trifle to get at them.

There are many places in a kitchen where such a drawer can be installed to advantage. Ice-boxes, built-in cupboards, air-shafts, adjoining pantries, store-rooms and closets offer numerous chances for putting in such a drawer, just at the very place where it is needed and where it takes up no room.



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